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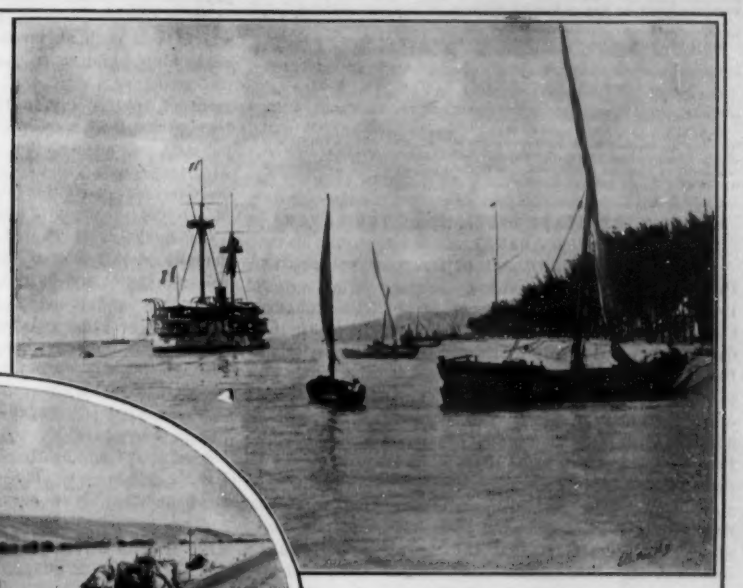
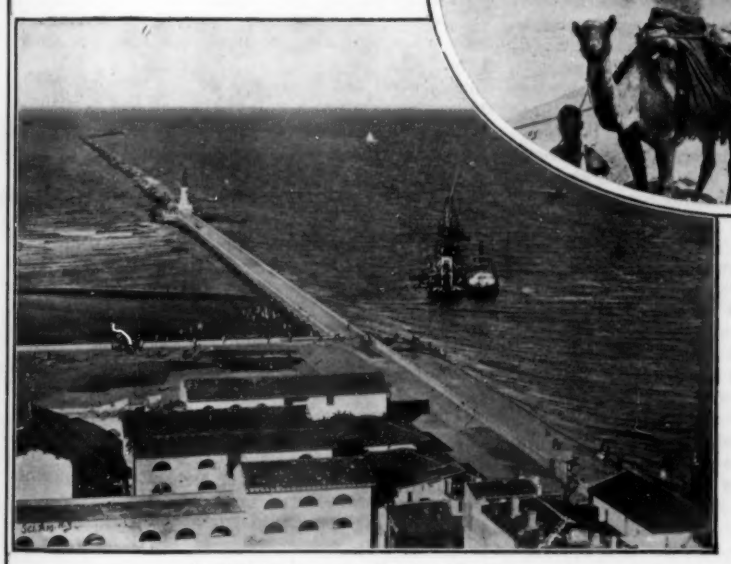
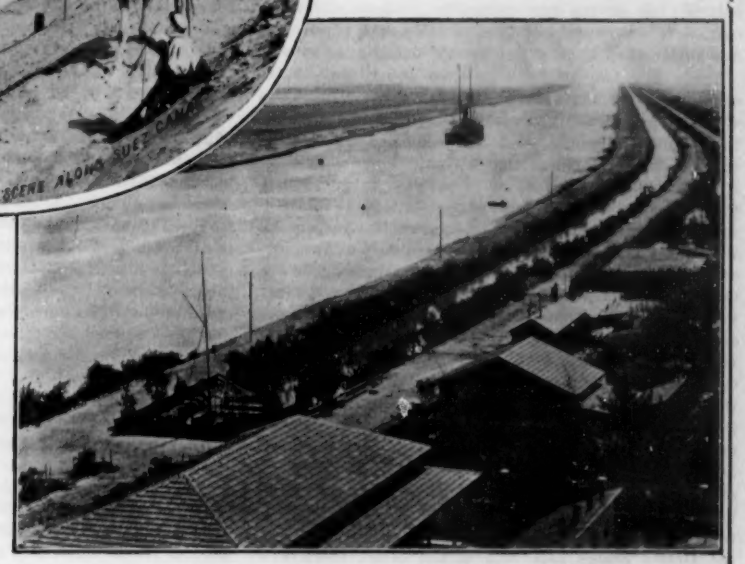
Port Said.



Entrance to the Red Sea.



The Mediterranean Sea from Lighthouse.



The Suez Canal with the Fresh-Water Canal Adjoining.

The West Breakwater with Statue of De Lesseps.

THROUGH THE SUEZ CANAL ON A UNITED STATES WARSHIP.—[See page 38.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, JULY 19, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE TWO IMPORTANT PROBLEMS OF THE PANAMA CANAL.

Ever since the recent Act of Congress authorizing the President to take such steps as may be necessary to acquire a clear title to the property of the Panama Canal Company and to arrange treaty rights with the Colombian government and to appoint a commission for the construction of the canal, it is with no little pride that it is recalled that during the past three or four years the SCIENTIFIC AMERICAN has persistently maintained that, all things considered, the Panama route seemed to be the most feasible and presented the greatest advantages from a practical point of view. It was about four years ago that the merits of this route were set forth in our columns, and we believe that the SCIENTIFIC AMERICAN has done its share in the work of education and in the removal of perhaps perfectly natural prejudice. It is not that we believe that there do not exist in the way of the completion of the work gigantic difficulties; but of the two routes, we believe the difficulties to be encountered in the Panama route are much less than at the Isthmus of Nicaragua.

There are two to be especially noted. One is a strictly engineering problem, and the other a question of sanitation. Taking the latter first—for if a work of this enormous magnitude is to be pushed through to completion, it is evident that we must make sure that it is possible for skilled and unskilled labor to live upon the Isthmus at Panama—we would impress upon our readers the fact that there is no respect in which the Panama Canal has been more unjustly assailed than in its reputed unhealthiness. It is unhealthy. But it is not by any means the "graveyard" which the opponents of the canal have persistently represented it to be. When the canal work was first started, and the proper methods of sanitation and the best means of fighting the local diseases were not understood, there was undoubtedly a frightful mortality; but of late years, by the employment of colored labor from the West Indies, most of which is immune from the local diseases, and by the exercise of great care on the part of the white population, it has been found possible to keep down the death rate to a reasonable figure. Now, we fully believe when the United States gets hold of the canal, there will be a still further and considerable lowering of the death rate. We base this belief upon the remarkably successful work which we have done in the new countries which came under our care after the Spanish war. The most notable instance of this is the fever-stricken and indescribably filthy city of Havana, where, after it had been for centuries in the grip of yellow fever, a few years of sanitation carried out according to American ideas sufficed to clean out the dread disease almost absolutely, and to turn a notoriously unsanitary city into one of decent cleanliness. As the Panama work proceeds, because of the unhealthiness of the locality there will, of course, be a certain amount of trouble, but the "graveyard" bugaboo will be found to have been grossly exaggerated.

The other great problem of the canal is of an engineering kind, and it will be found at the site of the great Bohio Dam, the most important structure on the whole work. The dam proposed by the Panama Company was to have been of clay founded upon hard clay, soft clay, sand and gravel. When the Isthmian Canal Commission made its investigation, it decided that for a work of this importance, security was a prime object to be aimed at. Hence they decided that as the sub-strata were of a more or less porous material, it was necessary to build either a masonry dam founded throughout upon rock, or an earth dam with a masonry core extending everywhere to rock; either of which structures would prevent seepage and effectually close the valley. Preference was given to a core-wall-and-earth dam. The structure as designed is to be 2540 feet in length along its crest, and its core wall will be carried down everywhere to rock, which in places will be reached at a depth of 128 feet below sea level. From sea level for a distance of 30 feet down cofferdams will be used in making the excavation, and from —30 to —128 feet the pneumatic process will be employed. The cost of the dam will be $6,370,000; and as it will probably take ten years to build, it will be the controlling feature in the question of the time of construction of the canal. Once built, in the manner suggested, however, it will be a structure that will stand for all time. A great deal has been said, and much will yet be heard, about the risks and even the impossibility of building such a structure by the pneumatic process; but while the work is, in some respects, unprecedented, there is no feature of it which is of such an untried character as to give any reasonable doubt to engineers as to the feasibility of the structure. Moreover, ten years in the development of engineering in the United States is a very long period, and we confidently expect that improved methods of construction devised by our ingenious American engineers and contractors will result in a considerable shortening of the period of construction below that estimated by the Commission.

Then again, it should be noted with a certain amount of satisfaction that the selection of Panama has been welcomed by the English press as an exceedingly wise and judicious selection. The future prosperity of the canal will certainly greatly depend upon the amount of European commerce which will pass through its waters after it is completed. A very large proportion of trade will, of course, be obtained through Great Britain and her colonies. It is gratifying to know, therefore, that in a commercial sense the principal engineering and marine papers of Great Britain believe the Panama route unquestionably a superior route from every point of view.

THE RAPID DEVELOPMENT OF THE SHIPBUILDING INDUSTRY OF JAPAN.

The development of the mercantile shipbuilding industry of Japan, noteworthy though it has been throughout the past few years, promises to be more remarkable in the future, if the present healthy outlook affords any criterion. The Japanese government is stimulating the enterprise by a subsidy of $10 per gross ton on vessels of 1,000 tons and on all vessels built in native yards and a lesser subsidy on smaller vessels. To this substantial encouragement must be added an additional subsidy of $2.50 per indicated horse power for propelling machinery. These are very material inducements, and they have naturally assisted in the development of the shipbuilding industry, which to the Japanese nation, owing to its insular position, is of paramount importance.

Coal is plentiful and consequently cheap, and so is labor. Skilled native artisans are employed for a wage of less than 50 cents per day. Strikes, lockouts and the domineering interference of trade unions are phases of civilization which as yet are practically unknown in the Far East. The average workman also is quite content to work on Sundays at the ordinary rate of wages. These advantages constitute a very substantial factor in the question of Japan's becoming her own ship constructor. All the shipbuilding yards in Japan, both government and private, would seem to have their origin in ship repairing, and from the ship-repairing industry to that of shipbuilding is a very natural transition. There are at present five important private shipyards in Japan, of which two are at Uraga, the others being situated at Nagasaki, Kobe and Osaka.

During the year 1901 the output of merchant shipping was under 7,000 tons, but as each succeeding ship is easier to build than her predecessor, on account of the plant provided, and the education gained by workmen and managers, it is with all Japanese yards rather premature to attempt to gage their future possibilities by the light of past performances. Baron Iwasaki, head of the Mitsu Bishi Company, of Nagasaki, has realized that even what is generally described as unskilled labor can be rendered more productive by education. He has, therefore, provided a school for the technical instruction of his workmen. Fifty lads ranging in age from 12 to 17 years are admitted each year, and they pass through a five years' course of instruction in shipbuilding, ship repairing and engineering. The education provided is free, and no pledge is exacted, or promise made, that the lads will, on the expiration of their pupil apprenticeship, engage in shipbuilding work.

PHOTOGRAPHY OF SOUND WAVES.

Mr. H. S. Allen, of the Blythswood Observatory (Scotland), has been carrying out some interesting experiments in connection with the photography of sound waves, and other disturbances of the air. The method of striæ devised by Toepler more than thirty years ago makes it possible, by suitable optical arrangements, to render visible disturbances in which the refractive index differs but little from that of air. In working this method for photographic purposes the source of light and its image must be of finite width, and the adjustments made so that a certain fraction of the width of the image falls on the screen, while the light from the remaining portion passes through the lens and gives rise to a uniform field. In these circumstances the upper part of the region of greater density appears against a light field, and the sensitiveness of the method depends on the relative proportion of the light stopped by the screen, and the light that enters the lens. One of the most striking applications of the method is the photography of sound waves—waves of compression set up by sudden electric discharges. The compression in one of these waves is considerable compared with that due to an ordinary musical sound. Attempts made to photograph the train of waves due to a musical note were successful, as were also efforts to secure a record of the notes from a shrill whistle, and a siren blown by a pair of foot bellows; but a number of photographs were obtained of the wave front of a train of waves from the oscillatory discharge of a condenser through a circuit possessing self-induction. In the latter case only the first wave front was secured; but although the attempt to photograph a train of waves was also in this case a failure, the result was not without interest, as it brought out very clearly the difference in character between the first discharge and the surgings that follow it when the spark is an oscillatory one. Several photographs were taken to show the formation of a vortex ring of heated air, from which it is seen that the air appears first of all to issue from the orifice in the form of a column, but the tail is gradually left behind, while the whirlpool motion of the head is accentuated. The appearance of some of these photographs showing vortex motion, as well as those of atmospheric disturbances caused by the burning of a spirit lamp and of a gas jet, resemble the published photographs of the nebulæ of the heavens.

EXHIBITION OF SCIENTIFIC DEVICES IN PARIS.

The Société Française de Physique recently held its annual exhibition in Paris, when a large variety of the inventions of the numerous ramifications of science, devised during the past year, were displayed. Notwithstanding the apparently exclusive name which it bears, this institution is international in its operations.

Some novel and interesting devices were exhibited. One contrivance was a wall of rippling and constantly changing colors of light, the effect being produced by a different series of electric lights, alternately switched on and off by a revolving wheel. This was intended as a startling attraction for fêtes or advertisement purposes.

One room was devoted to a practical exhibition of the varied utilizations of acetylene gas, among which the acetylene blow-pipe stood prominent. A practical example of how well acetylene gas is adapted for welding steel was given by an engineer. His eyes were protected with goggles similar to those utilized by automobilists. The blow-pipe was then brought to bear upon the requisite pieces of metals to be welded, and so terrific was the heat produced that the operation was accomplished in a few moments.

The two most valuable contributions to the show, however, were the devices of Prof. Curie and Prof. Pellat respectively. The former, who has long been engaged in the investigation of radium, exhibited the peculiar luminous properties of the substance. He had a small piece of radium measuring about one cubic inch, and which had cost $2,000 to produce. A German firm, when they received news of Prof. Curie's discovery some months ago, offered to extract a sufficient quantity of the substance from the salts of barium, at their own expense for the purpose of this exhibition. Several tons of the salt were required to produce even a cubic inch. This substance shines like a lamp, and also imparts a phosphorescent effect upon certain materials with which it is brought into contact, such as zinc sulphide. This is not a chemical, but purely a physical, influence. Prof. Curie displayed a retort containing a quantity of zinc sulphide, and connected the upper tube of the vessel with another retort containing a solution of radium. Immediately the zinc sulphide emitted a bright light. A small particle of radium renders phosphorescent a volume of zinc sulphide a thousand times its bulk. Another curious feature of the substance is that the zinc sulphide retains its phosphorescence for some time after the radium has been removed.

Prof. Pellat suspended a Crookes tube between two magnets. The effect produced was exactly the same as that which he obtained by transmitting a current through the tube. The colors in the tube varied, as the latter was turned one way or the other, thus showing the direction of the magnetic field.

Among the various X-ray contrivances exhibited was M. Benoit's "radiochromometer," an ingenious device for registering the degree of the penetration of the Roentgen rays. This invention consists of a series of disks of aluminium of various thicknesses, each layer being numbered consecutively from one to twelve. The

depth of the penetration of the rays is determined by the number of layers through which the rays penetrate. Thus if the rays penetrate through five layers the photo is a 5 X-ray picture.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY MARCUS BENJAMIN, PH.D.

The fifty-first annual meeting of this organization was held in Pittsburg, Pa., during the week of June 28 to July 3, 1902. It will be recollected that last year the American Association was convened in Denver, Colo., and this year met in Pittsburg in accordance with the time-honored custom of alternating a Western meeting with one in the East.

The sessions of the meeting were begun with a gathering of the Council on June 28, presided over by President Charles S. Minot, who fills the chair of Histology and Embryology in the Harvard Medical School, when matters of routine business, especially those pertaining to the filling of vacancies occasioned by the absence of officers, were considered.

The opening session was held in the charming Music Hall of Carnegie Institute on Monday, June 30, at 10 o'clock, when Prof. Minot, after calling the meeting to order, introduced as the presiding officer of the session Prof. Asaph Hall, U. S. Navy, retired, distinguished among astronomers by his discoveries of the moons of Mars, who is now connected with the Harvard Astronomical Observatory. An eloquent address of welcome was made by Dr. W. J. Holland, director of the Carnegie Museum, representing the Hon. J. O. Brown and the Hon. J. R. Murphy, respectively, recorders of the cities of Pittsburg and Allegheny, which was followed by an address by Col. Samuel H. Church, secretary of the Board of Trustees of the Carnegie Institute, extending hospitalities of that institution as a meeting place to the members of the Association. Finally Col. George H. Anderson, secretary of the Chamber of Commerce, Pittsburg, welcomed the scientists on behalf of the business interests of the great manufacturing municipality of Pittsburg. To these various addresses, a brief but appropriate acknowledgment was made in behalf of the Association by President Hall.

The various Sections then convened for their organization as follows: A, Mathematics and Astronomy, under the presidency of Prof. George W. Hough, of the Northwestern University; B, Physics, under Prof. William S. Franklin, of the Lehigh University; C, Chemistry, Prof. Henry A. Weber, of the Ohio State University; D, Mechanical Science and Engineering, Prof. John J. Flather, of the University of Minnesota; E, Geology and Geography, under Joseph A. Holmes, State Geologist of North Carolina, in place of Orville A. Derby, of Sao Paulo, Brazil, who was unable to be present; F, Zoology, Dr. Edward L. Mark, Professor of Anatomy at Harvard University, in place of Prof. Charles C. Nutting, who was absent; G, Botany, Dr. Charles E. Bessey, Professor of Botany at Nebraska University, in place of Douglas H. Campbell, Stanford University, who was unable to be present; H, Anthropology, Stewart Culin, of the University of Pennsylvania; I, Social and Economic Science, John Hyde, U. S. Department of Agriculture (in the absence of Carroll D. Wright, U. S. Commissioner of Labor); K, Physiology and Experimental Medicine, Dr. William H. Welch, of the Johns Hopkins University.

Sectional Committees were named, who then arranged the titles of the papers submitted to them for publication in the daily programme, after which they adjourned until the following day.

During the afternoon the retiring addresses of several of the Vice-Presidents were read. Among these was that before Section A, Mathematics and Astronomy, by Prof. James MacMahon, on "Some Recent Applications of the Function Theory to Physical Problems," which, owing to the absence of Prof. MacMahon, was presented by Prof. R. S. Woodward. The paper was a purely technical one, and therefore not suitable for a brief abstract. The address by Prof. D. B. Brace before the Section on Physics was on "Group-Velocity and the Wave-Velocity of Light." He traced the history of the measurement of the velocity of light from the time of Galileo to the present day, both by physical and astronomical methods. The highest accuracy at present attained was one part in 5,000. He showed that no method heretofore used in the laboratory had given the absolute velocity of light. He pointed out further that from astronomical observations light of all colors travels with the same velocity. He showed further that the observations by the American observers were superior to those of foreign observers, especially along the lines of electrodynamic experiments upon the velocity of light. Section D, on Mechanical Science and Engineering, listened to Prof. Henry S. Jacoby, who said that the application of scientific principles in the construction of bridges is to-day more complete than ever before, and that it applies to every detail of the work, from the manufacture of the material to the construction of every member in the bridges, and that the application of science in the construction of bridges is appreciated by the great railroad magnates, who have met the advance heartily, and fully realize the economic advantages resulting therefrom. Prof. Jacoby showed the necessity of bridges of greater durability in every way than heretofore to accommodate the heavily-loaded trains now used. Mr. B. T. Galloway, director of the Office of Plant Industry of the U. S. Department of Agriculture, addressed the Section on Botany on the subject of "Applied Botany—Retrospective and Prospective." He referred to the changes in botanical work during the past twenty years and to the great advancement made in it in ten years just past. He approved strongly of the State experimental stations established in recent years as of great assistance to the botanist. He recommended a course of training in botany for coming generations. The time, he thought, was ripe for it. "We have been informed," he said, "in this section of the possibility in years to come of the wheat crop ceasing to be sufficient to supply the demand, and such a thing comes directly under applied botany, and botanists should devote themselves to finding a kind of wheat which will grow abundantly enough to insure a sufficient crop." The Section on Geology and Geography listened to Prof. Charles R. Van Hise, who spoke on the training and work of a geologist. His abundant experience, both in college and in the field, made it possible for him to treat this subject in a full and comprehensive manner. He defined geology, and spoke of the absolute necessity of being familiar with the fundamental principles of the "basal sciences," in order to make a success in geology as a profession. The basal sciences he explained as being physics, chemistry, astronomy, biology, and mineralogy. He insisted that geologists must spend part of each year in field work and the remaining part in office and laboratory working out their outdoor observations. President David Starr Jordan of the Leland Stanford University was not present, but forwarded his address, which was on the "History of Ichthyology." His great knowledge of this subject made it an exceedingly interesting one to those who are devoted to that branch of Zoology, but it is unfortunately not suited for satisfactory abstraction. The Section on Anthropology listened to Dr. J. Walter Fewkes, who spoke on "Prehistoric Porto Rico." This island, which he had but recently visited, he declared to be interesting from an anthropological point of view. Before the coming of Columbus there developed in this island a culture sufficiently self-centered to be characteristic. Here was found a race living in an insular environment exceptional on the western hemisphere. There was nowhere on the American continent, at the time of its discovery, a people less affected by contact with other cultures or more truly the reflection of climatic conditions. Although the race was the first seen by Europeans, by whom it has been known for the longest time, comparatively little accurate study has been given it by the anthropologist. A great amount of archæological data yet remains hidden in the soil awaiting the spade of the explorer. Mr. John Hyde, statistician of the Department of Agriculture, delivered the address before the Section on Social and Economic Science. His subject was on "Some Statistical and Economic Aspects of Preventable Diseases," in the course of which he discussed the reduction of such diseases as small pox, diphtheria, yellow fever, and similar contagious complaints, giving statistics from the most authentic of recent authorities, showing the proportion of diminution of these diseases brought about in civilized communities by the introduction of sanitary improvements.

Beginning with Tuesday morning and continuing until the close of the meeting, the various Sections with the affiliated societies, which included the American Physical Society, the American Chemical Society, the Geographical Society of America, the Botanical Society of America, the American Anthropologic Association, and the American Folk-lore Society, met and discussed over three hundred and sixty papers, which is about one hundred and fifty more than were presented at the meeting held in Denver. It is not feasible in the short space at our command at this time to refer to any of these papers, even by title.

The great feature of the meeting was naturally the retiring address of the President. On this occasion President Minot chose as his theme "Consciousness in its Biological Aspects." In opening he referred to the meeting to be held in Washington during Convocation Week, and said for our next meeting we are to break with the long rule of summer gatherings, and assemble instead at New Year's time. To render this possible it was necessary to secure the co-operation of universities, colleges and technical schools to set aside the week of January 1 as "convocation week" for the meeting of learned societies. The plan, owing to the cordial and almost universal support given by the higher educational institutions, has been successfully carried through.

Then, passing directly to his subject, he began with the statement that consciousness is at once the oldest problem of philosophy and the youngest problem of science. The time is not yet for giving a satisfactory definition of consciousness. Opinions concerning it are many and diverse, but we are all agreed that the fundamental question is, "Does or does not consciousness affect directly the course of events?" Is it a true cause? Thus we encounter at once the problem of free will.

Consciousness ought to be regarded as a biological phenomenon, which the biologist has to investigate in order to increase the numer of veritable data concerning it. In that way, rather than by speculative thought, is the problem of consciousness to be solved, and it is because biologists are but beginning to study it that it may be said to be the newest problem of science. It is more important to seek additional positive knowledge than to hunt for ultimate interpretations. The biologist can very often tell why a given function is performed, but how the function exists he can tell very imperfectly. Consciousness is a particular example. The function of consciousness is to dislocate in time the reactions from the sensations. Consciousness is one of the fundamental functions of life, and yet has one of the smallest places in the realm of the biologist, although one of the greatest studies of the philosopher and psychologist. Years of patient labor must be passed through, but the result of the study will be great. Consciousness is to be viewed as a device to regulate the actions of the organisms so as to accomplish purposes which are useful to the organism. It has the power to change the form of energy, and is neither a form of energy nor a state of protoplasm. By this hypothesis there are two fundamentally different things in the universe—force and consciousness. Matter is not added because we have never had any evidence that matter exists. All our sensations are caused by force, and force alone.

As consciousness can initiate the change of the form of energy, it may be that without it the universe would come to absolute rest. Investigate consciousness by comparative observation. Correct, intelligent, exhaustive observation is our goal. When we reach it human science will be complete.

Three popular lectures complimentary to the citizens of Pittsburg were presented by members of the Association. The first of these lectures was by Dr. Leonard P. Kinnicutt, of the Worcester Polytechnic Institute, who spoke on "The Prevention of the Pollution of Streams by Modern Methods of Sewage Treatment." The second of these, given on Wednesday evening, July 2, was on "The Development of American Commerce—Past, Present and Prospective," by the Hon. O. P. Austin, Chief of the Bureau of Statistics of the Treasury Department. A third illustrated lecture entitled "The Recent Disaster in Martinique" was presented by Robert T. Hill, of the U. S. Geological Survey, on Thursday evening, July 3. Mr. Hill led an expedition to Martinique, sent out by the National Geographic Society, accounts of which have already appeared in the daily journals. These lectures were all enthusiastically received.

The Pittsburg meeting will rank as one of the most successful meetings ever held by the Association. The registration showed the presence of 436 members in attendance, which makes this meeting the twelfth in size of the fifty-two meetings previously held. It is the fourth in size of the meetings held during the last ten years. About sixty new members were elected during the meeting, and some eighty members advanced to the grade of fellows. A number of important measures concerning the future of the Association were considered, and amendments to the constitution were adopted, rendering the Council more permanent in its membership, and thus probably more efficient in its work, and also making the Sectional Committees so constituted as to render their greater efficiency a matter of practical certainty.

In accordance with the recommendation of the Council of last year, it was decided to hold the next meeting in Washington during Convocation Week, and for that event Ira Remsen, President of the Johns Hopkins University, was chosen President, and H. B. Ward, University of Nebraska, General Secretary, and some nineteen or twenty other officers were elected to supervise the different sections.

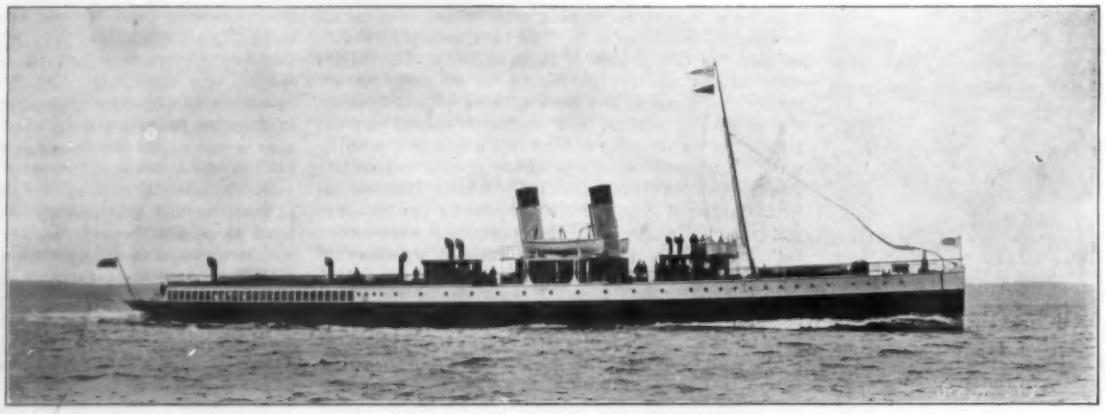
The New York Central & Hudson River Railway Company has awarded a contract for the equipment of its Putnam Division with the Hall system of automatic electro-gas block signals, which are to be operated on the normal danger plan. In this system the semaphore arms are held horizontally to indicate to the engineer danger ahead, or are drawn down by the pressure of carbonic acid gas in each signal post. The electrical equipment of the system consists in a valve which controls the flow of gas from the storage-tank to the cylinder. The valve is closed or opened by an electric current passing through the rails. The circuit is automatically completed by the train as it runs over the block ahead, and the approach of a train from behind.

MARINE STEAM TURBINES.

BY FRANK C. PERKINS.

As a result of the experience gained with the turbo-motored steamers "King Edward," "Queen Alexandra," and various other craft equipped with steam turbines, there is little reason to doubt that from now on this class of engine will be extensively used in the marine service.

The largest turbo-motored steamer afloat, the "Queen Alexandra," has recently been launched at the Leven Shipyard, at Dumbarton, England. It is a replica of the "King Edward," although larger, and was built by the same firm, Messrs. William Denny & Brothers, for passenger service on the Clyde. The "Queen Alexandra" is constructed very similarly to the older vessel, but has much larger dimensions, being 270 feet long, 32 feet in breadth and with a depth to promenade deck 18 feet 9 inches. This turbine steamer strongly resembles a small cross-channel steamer. There is no question but the appearance of the new vessel will be watched with great interest, as no less an authority than Capt. Williamson has declared himself in favor of the steam turbine for vessel propulsion, and the success of the "Queen Alexandra" will undoubtedly result in a large introduction of turbine machinery. A long shade deck has been provided, which is used as a promenade, and it also is used to carry the boats. Buoyant seats are provided on the promenade deck, which extends nearly the whole length of the boat, and many of them are well sheltered from the wind. A social hall is fitted up for the first-class passengers on the main deck aft. It is upholstered in velvet, and the ceilings are finished in delicate tints, while fine polished hardwoods are used throughout. There is a well-arranged tea-room on the port side, while the larder, scullery and galley are located forward of the boiler room on the main deck, and the smell of cooking is thus kept entirely away from the passengers' quarters. Abaft the turbines on the lower deck is the dining room for the first-class passengers, which will seat 100 people, and is well ventilated and lighted.



NEW TURBINE STEAMER "QUEEN ALEXANDRA."

Length, 270 feet; Breadth, 32 feet; Depth, 18 feet 9 inches.

Much important and valuable experience has been gained by the running of the first vessel constructed, the "King Edward," which was equipped with Parsons turbine engines of the latest improved type. In case reciprocating engines had been used, the best speed which could have been obtained would have been 19.7 knots, while 20.5 knots was actually done by the "King Edward." Of the increase of speed of 0.8 knot per hour, 0.2 was due to the lesser displacement of the vessel as a turbo-motored steamer, and 0.6 was due to the superior efficiency of the turbine engines and accessories. A gain in indicated horse power of 20 per cent is shown in the turbine steamer from the difference between 19.7 and 20.5 knots; but in reality it would be practically impossible to drive the "King Edward" at 20.5 knots per hour with ordinary reciprocating engines, as the additional weight which would be required would increase the displacement.

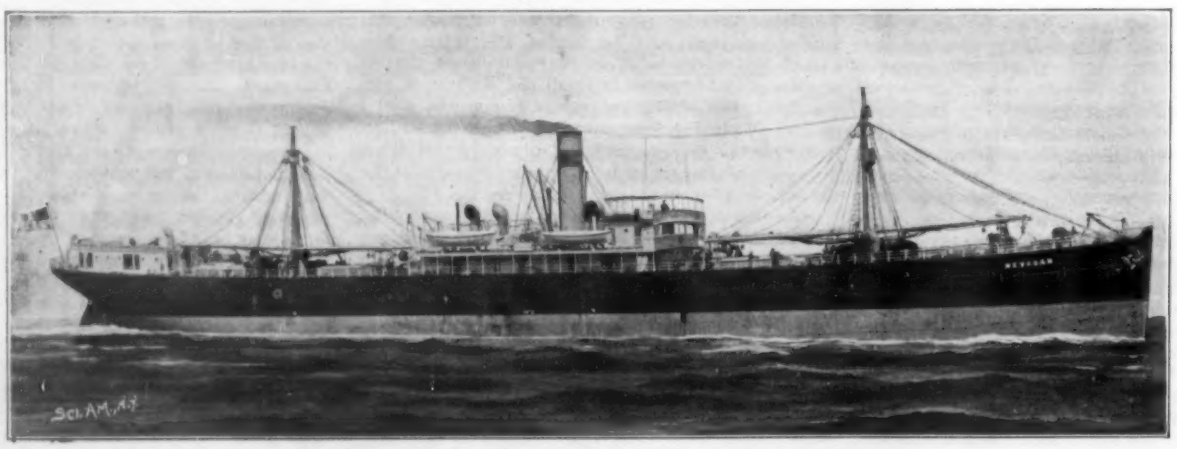
In reference to the coal consumption of the "King Edward," Mr. James Denny was able to give data very favorable to the steam turbine.

Under regular service conditions, a comparison between the turbine steamer and the "Duchess of Hamilton," which, however, was equipped with only compound engines, showed that the latter required 16 tons of coal when making 16½ knots, while the "King Edward" only burned 18 tons; and, even making proper allowance for the increased economy of the triple expansion engines of the latter over the compound engines of the "Duchess of Hamilton," if she were driven at 18½ knots, her consumption would be over 22 tons.

The "Queen Alexandra" is steered by steam steering gear, which is controlled by a wheel on the flying bridge. The main cables are worked by a powerful windlass, with warping capstan attached, which is fitted forward, while for warping the vessel alongside of piers there is fitted aft a steam warping capstan. Electricity is used throughout the boat for many purposes, including lighting, and the wiring is installed on the concentric system. A large double-ended boiler is employed, having a funnel at each end, and the steam turbines, which are three in number, are of the Parsons type, one being high-pressure and the remaining two low-pressure turbines.

FIRST OIL-BURNING STEAMSHIP BUILT IN THE UNITED STATES.

The steamship "Nevadan," recently built at the yards of the New York Shipbuilding Company, of Camden, N. J., for the trans-Pacific trade, is the first vessel in the United States to be constructed to utilize oil as well as coal for fuel. After the decision to build the "Nevadan," the discovery of this fluid in large quantities in Texas decided the American-Hawaiian Steamship Company to provide equipment for burning oil if possible, and machinery was specially designed for this purpose. The plan of supplying oil to the furnaces is somewhat similar to that used on locomotives, the liquid being injected in the form of spray by utilizing steam jets. The tanks are located at a considerable distance from the engine room, and will be connected with it by piping. The "Nevadan" is also provided with bunker room for carrying coal sufficient for the round trip between San Francisco and the Asiatic coast, if it is necessary to carry this tonnage.



THE "NEVADAN," THE FIRST AMERICAN OIL-BURNING STEAMER.

The steamship is one of the fleet which the New York Company has contracted to build for the American-Hawaiian Company for its service between San Francisco and the Hawaiian Islands. It is 371 feet in length, 46 feet beam and 34 feet depth of hold, with a carrying capacity of about 5000 tons cargo in addition to accommodations for passengers. The hull is constructed of steel, and is separated into several water-tight compartments. The engines are calculated to develop a speed of at least 15 knots an hour, while the ship is equipped with a series of modern steam winches for transferring cargo. It resembles in its general features one of the better class modern tramp steamships, so many of which have been constructed in Great Britain in recent years, with a view of carrying a large tonnage at a minimum cost. As in this class of vessels, the engines are located amidships. It is provided with two pole masts, to which are fastened the booms utilized in raising and lowering cargo from the hold.

All told, the fleet which the company proposes placing in service is comprised of nine vessels, three of which are 488 feet in length, 57 feet beam, and 35 feet depth of hold, having an average carrying capacity of 8700 tons; four vessels 435 feet in length, 51 feet beam and 33½ feet depth of hold, with a carrying capacity of 6000 tons, in addition to the two of which the "Nevadan" is a type. The oil-burning equipment of the latter vessel has been shipped to San Francisco, where it will be installed and a trial made during the first trip across the Pacific. If the tests are successful, it is understood that the other vessels under contract will be constructed with the same end in view. The "Nevadan" is on its way to San Francisco by way of Cape Horn. The work of the vessel will be studied with interest.

The End of the Pneumatic Gun.

No more striking illustration of the rapid improvement in ordnance is to be found than the abandonment by the United States government of the costly pneumatic gun plant at Sandy Hook.

In 1893 a contract was let for four 15-inch and two 8-inch dynamite guns. At that time extravagant stories of the weapon's power were circulated rather widely by the daily press. It was popularly supposed that these guns with their ability of hurling large masses of dynamite great distances rendered New York practically an invulnerable city. But about a year ago the Board of Ordnance and Fortifications made an elaborate investigation of these pneumatic guns, and upon their recommendation, the Secretary of War has decided to abandon the entire plant. The original cost of the weapons and accessories is said to have been $1,000,000. They were sold for less than $20,000 at a private sale.

Although the guns are no longer serviceable for the defense of New York harbor, they are not altogether worthless. It is said that the purchasers of the guns have sold one of them to the Turkish government for more than the price paid for the whole plant.

The reason for the abandonment of the Sandy Hook battery of pneumatic guns is not to be found in any structural defects, but simply in the improvement of modern ordnance. The pneumatic gun is the invention of Captain Zalinski, who devoted his entire energy to the invention of a gun which would surpass in destructiveness anything that had previously been devised. The range of the pneumatic gun is about two miles; the modern 12-inch and 8-inch army guns, on the other hand, have ranges that vary from 5 to 10 miles, and are, moreover, much cheaper. That, in a nutshell, is the reason for the change.

The only advantage which the pneumatic gun now has over the powder gun is its ability to throw masses of nitroglycerine or high explosives of equal power and sensitiveness without danger. It may be safely said that powder guns have so far not proven successful throwers of aerial torpedoes. But their cheapness and general efficiency fully compensate for this defect.

ANOTHER "HEAVIEST" LOCOMOTIVE IN THE WORLD.

The upward growth of the freight locomotive in weight and power continues without any signs of abatement; and although with the appearance of each successive monster freight engine, it would seem to the public eye as though the extreme limits of size and weight had surely been reached, this is so far from being the case that we have lately been assured by one of the most prominent locomotive designers in this country that his firm stands prepared, if there should come a call for it, to produce both express and freight locomotives that will far exceed any of the existing engines both in size, weight and power.

The massive, but very shapely, locomotive shown in our engraving was recently completed by the Baldwin Works for the Atchison, Topeka & Santa Fé Railroad. Its total weight is 267,800 pounds, and of this 237,800 pounds is carried on the five driving axles. The next heaviest locomotive is one which was built not long ago at Schenectady for the same railroad company, and that engine was about 8000 pounds lighter than the one here shown. The tractive power of this engine, that is to say the actual pull on the drawbar as she is working up to her full power, say at a speed of 10 miles an hour, is over 31 tons. It will be seen at a glance that the engine is of the tandem, compound type with piston valves, which seems to be growing increasingly popular. The high-pressure cylinder, which has a diameter of 19 inches, is placed forward of the low-pressure cylinder, which is 32 inches in diameter, the two pistons being carried upon a common piston rod. The stroke is 32 inches. The high and low-pressure valves are also carried on a common rod. The high-pressure valve is of the double, inside admission type. In operation the exhaust from the high-pressure cylinder passes into the interior of the high-pressure valve and occupies the lengthy valve-chamber which thus performs the office of a receiver; the low-pressure valve is an ordinary D-slide valve in its mode of action. In addition to the regular Westinghouse air-brake the engine carries the back-pressure brake; and both of these will be utilized in the heavy mountain service for which the engine has been it.

The ten driving wheels are 57 inches in diameter, and the truck wheels 29¼ inches in diameter. The driving axle journals measure 11 x 12 inches and the other axles 10 x 12 inches. The most colossal thing about this engine is certainly the boiler, which is of the wagon-top type and carries steam at a working pressure of 225 pounds. The diameter of the barrel is 6 feet 6¾ inches. The firebox is 9 feet in length by 6 feet 4 inches in width, with a depth at the front of 80 inches and at the back of 78 inches. There are 463 iron tubes of 2¼ inches outside diameter which measure 19 feet in length over sheets. The total heating surface in the tubes is 5158.8 square feet; the firebrick tubes have a heating surface of 23.9 square feet, while the heating surface in the firebox is 210.3 square feet, making a total heating surface of the whole boiler of 5390 square feet. There are 58.5 square feet of grate area.

The tender is built on similar proportions, the tank having a capacity of 7000 gallons of water, and 10 tons of coal. In closing, attention should be drawn to a pair of cranes which are permanently attached to the smokebox, one on each side. This is something novel on locomotives and they have been placed there for the purpose of facilitating the removal of the high-pressure cylinder, when it becomes necessary to inspect either the high-pressure piston or the piston rod packing between the two cylinders.

THE COLLINS WIRELESS TELEPHONE.

BY A. FREDERICK COLLINS.

There are at least five different methods by which articulate speech may be transmitted electrically without connecting wires between two given points. The first and oldest of these is by conduction through land and water. In this system four conductors are earthed, two at the transmitting and two at the receiving end. In this way a portion of the current, passing through the transmitting circuit, is shunted by means of the earth between the instruments and acts upon the receiver, since this path offers the least resistance.

THE COLLINS WIRELESS TELEPHONE.

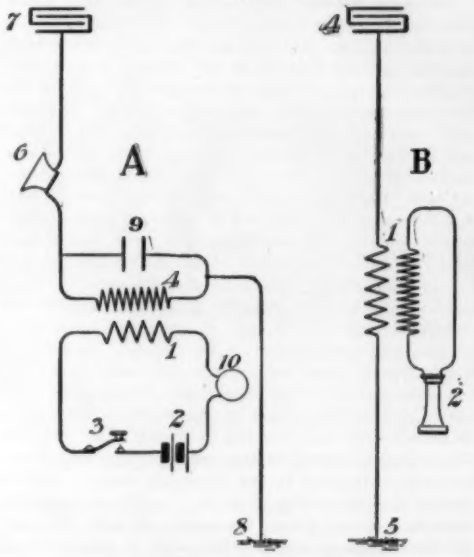


DIAGRAM OF WIRELESS TELEPHONE.

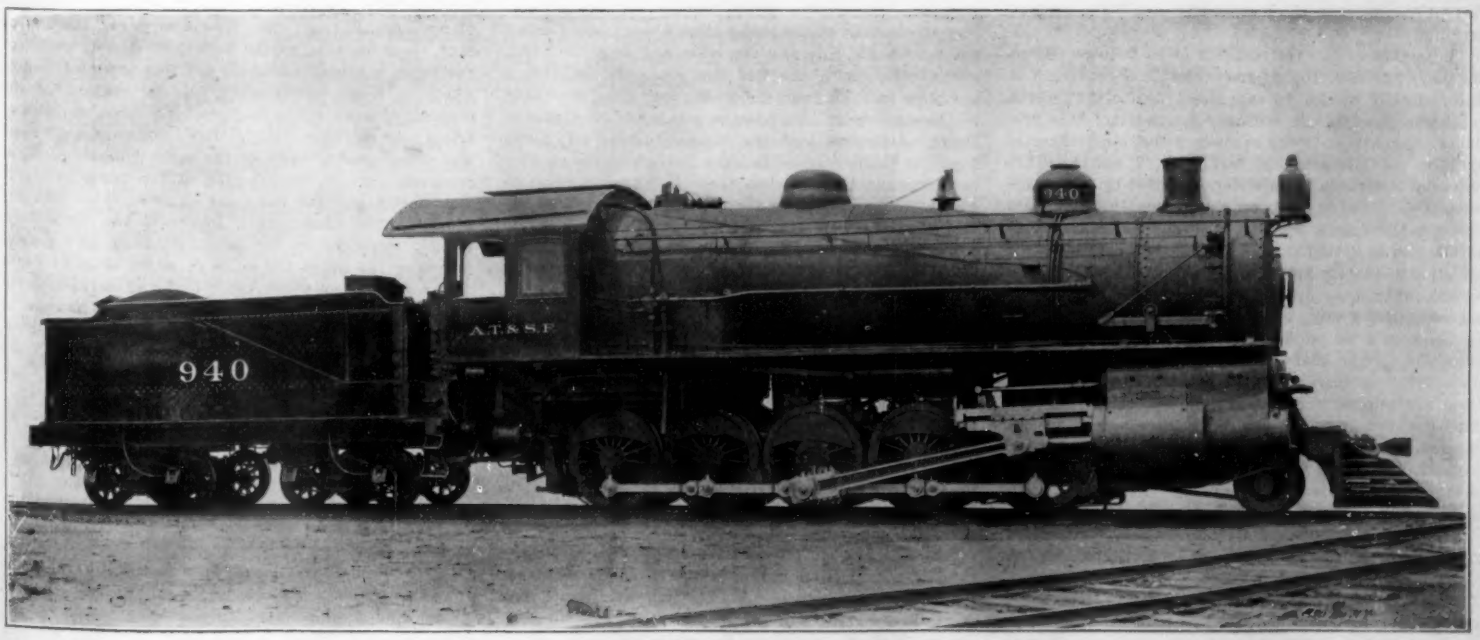
As early as 1825 James Bowen Lindsay operated a system of wireless signals by this method, but by substituting a telephone transmitter for a telegraphic key and a telephone receiver for the galvanometer speech may be as easily sent as a signal. This is usually the first method suggested to the inventor seeking to transmit articulate speech without wires, but a very few quantitative tests will show that the limitations appear almost before its commercial value begins.

The second and most beautiful form of wireless telegraphy is due to the effects of mutual induction or the magnetic lines of force exerted by one coil of wire on another placed in the same field of force by mutual induction. This is the ideal system, since no earth connection either at the receiver or transmitter is necessary to effect transmission, but the action is due entirely to the electric whirls or vortices set up in the ether. In this case the effective distance to which speech may be sent is limited by the number of turns of wire on the coil; their distance apart and the mutual induction will then depend upon the current flowing in the primary. Like the former system, the limits are soon reached.

The radiophone and speaking telephone are two forms employing a beam of light to transmit telephonic messages. A pencil of light is allowed to fall on a mirror fastened to the diaphragm of a telephone transmitter, and by means of lenses the light is focused on a selenium cell at a distance of two or three hundred feet. In series with the selenium cell is a telephone receiver and a battery. When the sound waves of the voice impinge on the diaphragm of the transmitter, its vibrations cause the light to be displaced and its intensity on the selenium cell varied. Now selenium possesses the property of transmitting an electric current with twice the conductivity value when in the light that it possesses in the dark, so that there is a wide divergence of conductivity assured when the constantly varying beam of light falls upon it, and thus articulate speech is reproduced.

The fourth system is that employing Hertzian waves, but as the enormously high-frequency oscillations produced by the disruptive discharge of a high potential current is much too rapid to make itself manifest in a telephone receiver, the oscillation circuit which emits the waves must be damped down by the addition of capacity in the form of Leyden jars or condensers and its relation to inductance sustained by supplementing the capacity with coils of wire until the telephone receiver will respond to a vibration of electric oscillations. This system of wireless telephony offers the most interesting experimental field of investigation, but its functions are so complicated that a very limited distance has yet been obtained with it.

In making some tests in 1899 I found a method by which the disadvantages of the very rapid oscillations set up by a disruptive discharge in free air, as the spark of a Ruhmkorff coil produces, and without resorting to the loading of the oscillating circuit with artificial capacities and inductances. This was accomplished by permitting the discharge to take place in the earth instead of the air. To render this process



THE LATEST "MOST POWERFUL LOCOMOTIVE IN THE WORLD."

Cylinders: High-pressure 19 inches diameter, low-pressure 32 inches diameter, common stroke 32 inches. **Boiler:** Diameter 6 feet 6¾ inches, length of barrel 19 feet, firebox 108 inches long, 78 inches wide by 80 inches deep, total heating surface, 5,390 square feet. **Weight of Engine,** 267,800 pounds. **Drawbar Pull,** 31 tons.

clearer, let us employ, not only as a mere analogue, but as a similar proposition, the fact that electric oscillations emit electric waves, just as an electrically charged vibrating atom sends forth waves which are likewise of electromagnetic origin formed by the polarization of the ether. Even alternating currents of comparatively low frequency of a few thousand per second will emit long electrical waves in space, as Guarini has shown in his experiments in wireless transmission between Antwerp and Brussels. The length of the waves depends on the periodicity of the oscillations, the oscillations on the inductance, capacity and resistance of the circuit, and these in turn on the constants of the ether.

The constants of the ether are its elasticity and its density. The elasticity of the ether is not known absolutely, but is measured by its reciprocal or dielectric constant, which is the ether modified by its relations with gross matter, and is called its specific inductive capacity. Ether, when in close proximity with gross matter, apparently assumes a greater density than in vacuo or free air, however paradoxical it may seem; it is now well known that it is not the conductor or wire joining an electrical circuit which conducts the electricity, but the tube of ether including the wire. The atoms of which the earth is composed are likewise permeated with the ether to a much greater extent than the atoms of gases forming the air. To this condition Tesla has given the name of *bound* ether. Similarly as mediums of greater densities transmit sound waves to greater distances than mediums of lesser densities, so the bound ether of the earth will propagate electric waves of proper length to greater distances than those of the ether-bound air. As an illustration, in the case of sound waves, if a bell is struck in free air it can be heard at a distance of a mile, it could be heard at a distance of twelve miles if struck under water, for water has a density twelve times that of air; now, when a rapidly alternating current of high potential is discharged into the earth and there allowed to restore the equilibrium, electric waves are emitted and propagated through the earth; the length of the waves is determined by the frequency of alternation and the distance of propagation will depend upon the density of the medium.

These waves are, of course, normally radiated in every direction, but it has been found possible to reflect them and so make them unidirectional within certain limits. Fig. 1 shows photographically the wireless telephone transmitter the author devised for field work. Fig. 2 is a diagrammatic drawing of the system which has been patented in the United States and Great Britain. In the patent specifications a telegraph key is substituted for a telephone transmitter, as the system is interchangeable and may be used either for wireless telephony or telegraphy with some minor changes and additions.

Referring to Fig. 2, *A* is a transmitter and *B* the receiver. The primary coil is shown at 1 and is in series with the battery, 2, and the key, 3. One terminal of the secondary winding, 4, is connected with a special form of transmitter, 6, and this to a large capacity, 7. The opposite terminal of the induction coil is earthed at 8, and bridged across the terminals of the secondary is the condenser, 9; 10 is a "variator," which will be again referred to. The receiver is quite simple and consists essentially of a transformer coil, 1, a telephone receiver, 2, and a battery, 3; the condenser, 4, of large and equal capacity to that employed in the transmitter, and 5 the earthed terminal.

The action of the instruments is as follows: When the key, 3, closes the primary circuit the current is automatically varied by a special device, 10, which takes the place of the ordinary interrupter; this produces alternations in the secondary coil, 4, giving rise to high potentials at the terminals, 7 and 8. This potential difference is, however, modified by the transmitter, 6. The surging of the alternating currents through the circuit formed by 7 and 8, emits waves principally at 8, and these traveling with the speed of all other electromagnetic waves reach the earth plate, 4, and, finding an ether path of greater density surrounding the circuit, 4 and 5, it traverses that circuit in preference to passing onward through the earth, since the former offers the least resistance. This sets up alternating currents in the transformer coil, 1, and these are impressed on the telephone receiver, 2. The capacity areas, 4 and 7, should be large and of special construction to secure the best effects. The capacities, 4 and 7, are not elevated, and the larger the capacities the greater the distance over which articulate speech may be carried without wires.

Both the transmitter and receiver are mounted on tripods providing the operators with testing apparatus almost as portable as a camera. The tests, from the incipiency of the idea of wireless telephony, have been made at Narberth, Pa., where the conditions were all that could be desired. In 1899, speech was transmitted by this system a distance of 200 feet; in 1900 a mile was covered, when with the equipment shown in the engravings articulate speech was transmitted across the Delaware River at Philadelphia, and in 1902 with the instruments placed on hills separated by a railroad, valleys, wooded lands and numerous streams a distance of three miles was attained. The results have shown the possible commercial value of this system of wireless telephony, which is soon to be perfected for actual use.

THROUGH THE SUEZ CANAL ON A MAN-OF-WAR.

BY H. H. BYRNE, U. S. N.

About noon, August 14, 1901, the U. S. gunboat "Castine," then returning from the Philippine Islands, dropped her anchor at Port Tewfik, once called Port Abraham, the southern terminus of the Suez Canal. It is not the city of Suez that is located here, as is generally supposed, for that city lies about three miles to the northwest of this place.

The city of Port Tewfik is an exceptionally small place, the inhabitants hardly exceeding a few hundred, in fact the only evidence of life is a few wandering Arabs along the quay, and an occasional donkey or camel. You cannot form your opinion from these observations, however, for at the noon hour very nearly all of the inhabitants are taking their daily siesta, an essential requisite for anyone desiring average health in Egypt. If you wish to see Port Tewfik, go ashore at sunset, then you will see on the water front roadway the inhabitants taking their daily walk or drive; for all are more or less interested in the ships just arrived from the Red Sea and Port Said.

About sunset the pilot came aboard and announced everything ready for our trip "across the desert," which we were to make during the night, an immense searchlight having been rigged over the bow for the purpose. After a few moments' delay, caused principally by the natives remaining on board until the very last second in their efforts to make just "one more sale," we "up anchored" and started on our journey.

THE GREAT SUEZ.

The plans for the construction of the Suez Canal were by no means originated by De Lesseps, for as early as the year 1640 similar ideas were entertained but not matured because of an existing superstition. The Red Sea was thought to be above the level of the Mediterranean and any connection of the two would only result in the disastrous flooding of that entire part of Egypt. De Lesseps, however, deserves the distinction of bringing the possibility of his plans before the eyes of the world sufficiently well enough to warrant its commencement and of directing its construction to complete success. A company was formed and after obtaining the consent of Egypt, Turkey, Russia, France and Austria, but not of Great Britain, work was actually begun under the immediate supervision of Daniel Lange in the year 1858, just six years after its idea had originated with De Lesseps. In its first stages forced labor was universally used; this was, however, objected to by Egypt and was stopped soon after; in 1862 the waters of the Mediterranean were connected with Lake Temsah by means of an artificial channel independent of the canal. The existence of this and other lakes in the immediate vicinity and by reason of evidence found in the canal's construction, serve only to corroborate the sayings of geologists that the Mediterranean and Red Sea were at one time one body of water. In the early part of 1869, that part of the canal between the lakes and the Mediterranean was opened to traffic. While this section was in progress, there was at the same time a connection being made with the Nile and the lakes and from this vein a connection with the Red Sea via Suez; in 1869 a complete passage from sea to sea was announced and in the same year this passage was made by Clarence Paget, an English lord, the itinerary of the trip being from the Mediterranean to Lake Temsah by the smaller or independent route, then through the main canal to Bitter Lake and then by the fresh water route into the Red Sea. In addition to irrigating the land in its vicinity, this water-way served as a reservoir to the cities of Port Tewfik and Suez, a decided necessity at those places, for previous to that time, a great portion of the inhabitants used water imported from so great a distance as Cairo and Alexandria. In November of the year 1869 the main canal opened for traffic in the presence of the Emperor of Austria, Empress of the French and Viceroy of Egypt. Thus in eleven years the greatest feat ever attempted in engineering was successfully performed in spite of the incessant predictions to the contrary by some of the leading engineers of that time. I will quote here an article taken from the Edinburgh Review concerning the possibility of constructing a breakwater at the Mediterranean entrance. It says:

"Any construction attempted so as to form an entrance for the canal will be swallowed up. Every block, every stone will be swallowed up, and we shall not see a single one above the water."

Although in 1869 a passage was made by direct route from England to Australia in about two-thirds the time formerly required, it should be remembered that several years before that time it could be done also, only by a more complicated passage, for as early as 1863 ships leaving Liverpool and Marseilles traversed the Mediterranean bound for the Suez Canal where their cargoes were discharged into lighters of light draught and towed by tugs to Port Tewfik where they were again discharged into large steamers in waiting bound for India, China and Australia. This seems to have been a complicated mode of transportation, but when the only other routes are considered, those of Cape Horn and the Straits of Magellan with their danger to shipping as well as the increase in distance, it is easily proved that the Suez route was the better of the three. The advantages of this passage were three-fold, in addition to the facilities gained in shipping, the voyage was made under circumstances more agreeable and in much shorter time to the East, and last but not the least important, it yielded a revenue to the Canal Company much needed at that time, for in view of the adverse predictions as to the canal's success, funds were not freely appropriated by the French government, who were then fostering the enterprise.

By 1870 the canal's traffic doubled that of the year previous; in 1875 that number was quadrupled; during the year 1880, 2026 vessels passed through, or between five and six a day; in 1882 this increased to eight a day; during the year 1890, 3389 passed through, between nine and ten a day; over 74 per cent of which were British; the total receipts for this year were about $12,500,000, at an average cost of between three and four thousand dollars' toll for each ship, and of this amount $5,000,000 was spent in the maintenance of the canal, thereby giving a net profit of $7,500,000 to its owners.

In 1873 the charges for toll were doubled; this action caused the British shipowners to ask for a national conference which was held at Constantinople in December of the same year; this was followed by a protest from De Lesseps; his agent, Mr. Lange, informed those at the conference that unless back dues were paid the canal would be closed to their traffic. After much discussion the matter was compromised to the satisfaction of both parties. In May, 1883, trouble again occurred between England and the Canal Company, whereupon the former determined to build a second canal; for this purpose a syndicate was appointed and met in November of that year, but before any action was definitely agreed upon De Lesseps compromised by agreeing to reduce the rates and to widen the canal. This practically ended trouble of any serious nature between these parties and since that time England has purchased Egypt's shares, whereby she now owns an extensive controlling interest in its administration.

In view of the construction of our own canal, about to be begun, a few remarks here on the construction of the Suez will give a faint idea of the labor necessary. When the forced labor was finally prohibited by Egypt the company was confronted by very grave obstacles. Necessity, however, soon invented a steam dredge which after many experiments worked successfully; tracks were built on either side of the route on which these dredges mounted on cars traveled; by means of an arm, an endless chain with scoops attached was so arranged as to drag from the middle of the ditch inward; this dirt was carried away by hand labor, horses, mules and camels. Among the laborers were immigrants from most of the countries of southern Europe; the officials arranged matters so that these helpers would be assorted into gangs of their own nationality thereby averting any race trouble likely to occur. They were paid in money for the amount of work performed, making from one to two and a half shillings a day. The amount of work done was determined usually by the cubic contents of earth removed. In the construction of the canal before it was finally widened the total excavation reached 80,000,000 cubic yards; this, however, has since been greatly increased, as the latest statistics give a total length of 100 miles (20 miles of which is lake) depth 31.2 feet, bottom width 108.2 feet and surface width 420 feet; these dimensions will allow the passage of any ship drawing not more than 25 feet of water. The British cruiser "Powerful" on her passage from England to China was obliged to go by way of Cape Horn because her draught was above the standard.

The rules governing ships while making the passage are many; a few of the more important are that every vessel is required to have a pilot; the captain of each ship is required to furnish, before entering, a complete list of passengers on board, for each of which a toll of $2.50 is charged; in cases of merchant vessels and men-of-war a copy of the muster roll is required; all life boats must be rigged inboard, a cutter shall be towed astern carrying the end of a hawser, to be used in mooring the boat aside to allow the passage of another steamer. Ships having made over half the passage are allowed the right of way, and mail steamers are allowed the right of way at all times.

The total cost of the canal when completed was $102,750,000.

The next place of interest is the city of Ismailia, situated on Lake Temsah; this is the central point of the canal and is a comparatively large town, its inhabitants numbering about 5000 (mostly French). The homes of the pilots are situated here; there are also hotels, shops, cafés, a theater and a central railway station. The remainder of the trip is of little interest aside from camels and their masters who can be seen bound for different parts of the desert.

On arrival at Port Said we completed our journey in fourteen hours. The first thing to take the eye at this place is the activity of the port; here are assembled ships of every nation, some coaling or discharging cargo, while from seven to eight are probably awaiting their turn to enter the canal. The city of Port Said is, in comparison to cities in that part of the world, a modern place; previous to 1860 it was not in existence, but since the building of the canal, it has developed from a camping center into the "half-way house" of the East and West. At the latest census it had a population of 10,000, consisting more or less of a mixture, representing every nationality on the face of the earth. The streets are wide and very clean, and as for places of amusement, it has its share of music halls, their incomes being principally derived from travelers stopping at the place on their way through the canal. One of the principal points of interest is the light-house, a structure 180 feet high, and for many miles at sea it determines the entrance of the canal.

It was in the making of this entrance that De Lesseps found his greatest opposition; his opponents predicted that the constant supply of mud and sand brought from the interior of Africa by the Nile would block any plan devised for the canal's entrance at this place. He persisted, however, and constructed two breakwaters, one on either side of the canal to converge toward the sea entrance; these walls were made of stone carried from a great distance and at enormous cost. When partly finished, artificial stone was made on the spot and was used in its completion.

On the western breakwater about a mile from shore is situated the statue of Ferdinand de Lesseps, with his right arm raised and his hand pointing to the south; you almost imagine you can hear him say "My canal."

The Boston-New York Motor Bicycle Endurance Test.

The first long-distance endurance test of motor bicycles that has ever been held was that which took place on July 4 and 5 over the 254 miles of road leading from Boston to New York. The course was divided into ten controls, and each contestant was allowed a certain minimum and maximum time to cover a control. A perfect run through every control gave the contestant 1000 points, and unlike what has heretofore been the rule in other endurance tests, if he failed to make a control within the maximum time limit, he was not out of the test altogether, but, upon reaching it, was given a certain number of points.

Out of thirty-one starters, seventeen succeeded in reaching Hartford, Conn., the halfway point. Most of the machines that failed to reach this point gave out before traveling seventy-five miles of the journey. The following day, out of the seventeen survivors at Hartford, thirteen succeeded in reaching New York. This was a remarkably good showing, considering the state of the roads, which were rutty and very muddy. The test was a most severe one to riders as well as machines, and many tumbles were reported on account of the slippery roadbed. One of the contestants was so badly hurt from a fall that he had to be carried to a hospital.

The performance of the machines of several of the first motor bicycle manufacturers in the country shows that those earliest in the field have profited from their experience and are now producing perfectly practical motor bicycles, which on good roads are capable of carrying a rider at fast speeds with safety and without breakdowns. The winning of the contest by one of these manufacturers, who had entered but a single machine, speaks well for the reliability of his motor and the general construction of the bicycle.

Clothed with the authority of the Naval Appropriation Bill, Secretary Moody has given orders for the construction, at Brooklyn, by the government, of a 16,000-ton battleship. The Department will begin working out the detail plans immediately; and it is hoped that the keel-plates for the vessel will be laid in about eight months.

In order to determine the condition of New York city's air, Street Cleaning Commissioner Woodbury is exposing gelatine plates to collect germs.

Correspondence.

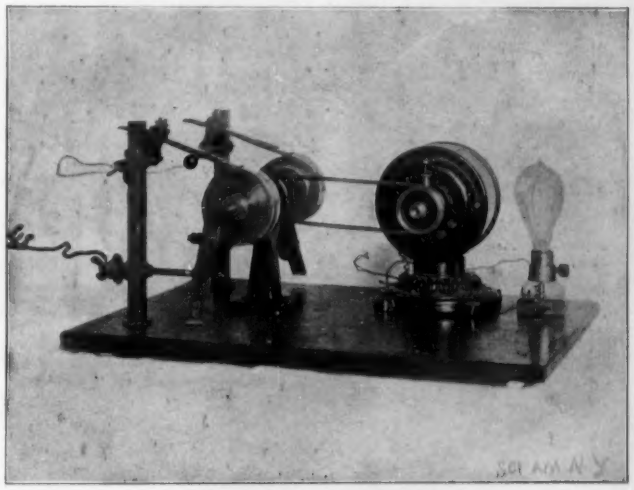
THE GRISSON CONTINUOUS-ALTERNATING CURRENT TRANSFORMER.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 28, 1902, an illustrated description of the Grisson continuous-alternating current transformer, by Mr. A. F. Collins, occurs on page 452. Possibly some of your readers who are occupied with wireless telegraphy may care to hear further details regarding the practical working of an identically similar apparatus, independently devised by myself over four years ago to actuate an induction coil containing a primary with two circuits, so that the secondary discharge would be alternating in character. Although the apparatus was consigned long ago to the junk shelf, it happens to be still in my possession; and, as can be seen from the accompanying photograph, its plan is identical to that figured by Mr. Collins. At the time I attempted to satisfactorily employ this form of double rotary current distributer for the above-mentioned purpose, it was used in conjunction with both core transformers and induction coils in which the primary circuits were doubled, as figured by Mr. Collins. With neither type of apparatus, however, were satisfactory secondary discharges obtained, while considerable pyrotechnics always occurred at the brushes unless the current transmitted was kept below two or three amperes and two separate condensers were connected across the brushes of each wheel. With an induction coil giving normally a spark of eight inches, a spark of only one inch could be had without condensers, and one of two and a half inches when suitable condensers were used. When shunted by the condensers, the contact maker would usually run for a few moments with very slight sparking at the brushes, but frequently either at one or both brushes a prodigious flaming would occur, accompanied by a sudden increase in the primary current from three to forty or fifty amperes, when the 115-volt continuous current formed the source of supply. Hence the discharge was extremely irregular, and the wear and tear upon the mica insertions of the wheels so great that after very brief runs truing was required. By employing in the above-mentioned induction coil a primary wound with four layers along its whole length, which were connected so as to use the inner and outer layers in series for one circuit and the two middle layers in series for the other, thus approximately equalizing the inductances of the two circuits, the length of the spark obtainable from the secondary was increased to three and a half inches, although the behavior of the contact wheels as regards the constant tendency to flame was unimproved. When core transformers were used instead of induction coils, the results were equally as unsatisfactory. When several cells of storage battery supplied the current, the sparking at the brushes, as would be expected, was much diminished, but the performance of the induction coil was nothing like as good as when the usual spring vibrator was used to interrupt the current.

From the preceding experiences it appears that this method of directing the current first through one winding of the primary, and then leading it suddenly in the reverse direction through the other winding, does not cause a variation of the primary current at all suited to induction coils. If, however, the current through either primary winding is suddenly interrupted when at its maximum value, and suitable condensers are connected as usual across the break, the spark length of the secondary alternating discharge fully equals that obtained from the same induction coil as if it were actuated in the orthodox fashion. Although the employment of this high-potential alternating discharge is found to be necessary for actuating a special form of X-ray tube used in my form of the stereo-radioscopic apparatus, it seems to me that nothing is to be gained by using it for wireless telegraphy, unless the complex method necessary to produce such a discharge absolutely eliminates all the various disturbing factors which arise when other well-known devices are used to interrupt the primary current.

R. H. CUNNINGHAM.



ALTERNATING CURRENT TRANSFORMER.

Galileo Ferraris Prize for Inventors.

The committee for the "Galileo Ferraris Award," instituted in 1898, have decided to open an international competition for the award of said prize on the occasion of the unveiling of the monument to Ferraris, in Turin, in the latter half of the month of September next. The award is 15,000 lires ($3000), together with the compound interest accumulated since the year 1899 up to the day of the award. The prize will be granted to the inventor of some practical application of electricity likely to lead to noteworthy progress. Competitors may submit either pamphlets, projects and drawings or machines, apparatus and appliances relating to their invention. The jury has full power to cause practical experiments to be made with the inventions entered for competition, and upon the corresponding apparatus. Competitors are to file their applications and deliver their credentials appertaining to their invention not later than 6 o'clock P. M. on the 15th of September, 1902, at the office of the secretary of the committee, care of the Administrative Committee on the First International Exhibition of Modern Decorative Art in the buildings of the Chamber of Commerce and Art, 28 Via Ospedale, Turin, Italy.

Proposed Steel Automobile Road.

The Steel Roads Committee of the Automobile Club of America is making rapid progress in its work, and through its energy, together with the liberality of the United States Steel Corporation and the hearty co-operation of the city authorities, a thorough demonstration will very soon be made in this city of the merits of the steel highway system under various conditions of service. The chief difficulty was to get the special shape of steel rolled; none of the outside mills were willing to furnish it, or even to take an order for regular sizes requiring prompt delivery, but when Chairman Seligman of the committee met President Schwab he found him in full sympathy with the movement, and ready not only to furnish the special forms and deliver them promptly, but to contribute the steel for a mile of road as a gift. General Stone, the designer of the proposed road, has already conferred with the steel corporation's experts on the details of construction and the material will be delivered in six weeks. President Cantor has shown a warm interest in the affair, and by his direction Chief Engineer Olney is to recommend suitable locations for sections of the road. It is intended to place one in the heavy trucking region down town, another in a street of general travel, and a third on a suburban earth road. The track plates will be 12 inches wide and will be laid on special foundations of broken stones. An English engineer, who recently inspected the steel road at Valencia in Spain, reports in the highest praise of it in every particular. This road has been in use for ten years.

The Current Supplement.

The current SUPPLEMENT is one of the most important which has appeared in some time. The first article is an interesting illustrated description by E. C. Rost of the methods of cultivating coffee in Brazil and in the Philippines. Antarctic exploration just now is occupying the attention of many geographers. For that reason Edwin S. Balch's discussion of the subject is rather timely. A new census machine is described and illustrated. Frank C. Perkins writes entertainingly of vertical direct and alternating generators used in Switzerland. Capt. John Stephen Sewell discusses the important subject of electricity in its application to submarine mines. A very complete paper on blue-print and black-print photographic papers and their preparation, from the pen of Mr. Alfred I. Cohn, is of rare value. The new model filter plant of the city of Middletown, N. Y., is described in a handsomely illustrated article. Prof. Henry S. Jacoby read before the last meeting of the American Association for the Advancement of Science a most valuable paper on the recent progress in American bridge construction. That paper is published in full. Two technological articles, one on the "Making of India Ink" and the other on the "Recovery of Rubber," are of exceptional value. The usual Consular Notes and Selected Formulæ will be found in their accustomed places.

MILK IN POWDERED FORM.

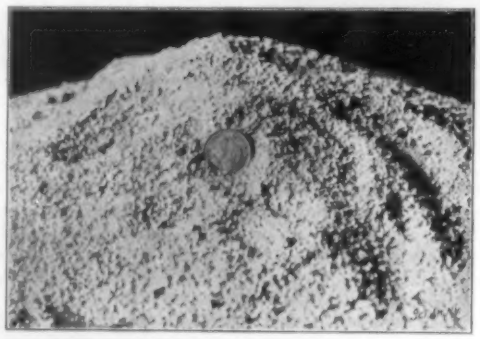
BY GEORGE J. JONES.

For more than fifty years efforts have been made by the scientists of nearly all the civilized countries to separate the water and the fat from milk and secure the non-fatty solids in such condition that by the simple addition of water the milk could be restored, with all its original properties unimpaired, and unchangeable by time or the extreme variations of climate.

These efforts proved unsuccessful for many years. A portion of the water could be readily removed, but when concentrated to about one-sixth of its original bulk the pasty condition of the mass rendered it unmanageable and complete desiccation became impossible without subjecting it to such a high temperature that the character of the product was completely changed, rendering it insoluble, incapable of coagulation by rennet and reducing the digestibility by pepsin tests 50 per cent. The nearest approach to desiccation was condensed milk. A dry product seemed impossible without the sacrifice of all the valuable constituents of milk except the casein, and this was preserved only in an altered form after treatment with acids and alkalies which thoroughly changed its character and impaired its nutritive qualities.

Dr. Joseph H. Campbell, a citizen of the State of Pennsylvania, who had spent a great deal of time in the study of the petroleum products, turned his attention to organic chemistry some time ago, devoting himself especially to the products of the dairy.

The developments of the dairy interests of this country had reached enormous proportions. The butter industry was largely being concentrated at the creameries, and in many cases skim milk was a waste product, often thrown away. If the skim milk could be utilized so as to recover the non-fatty solids in dry, soluble, sterilized and thoroughly peptogenic condition, the product at half the price of butter per pound would be more valuable than the butter interests itself, as the milk would yield but four pounds of butter to the hundred pounds of milk, while the non-fatty solids would furnish nine and a half pounds of the dry powder, and the annual value would run into hundreds of millions of dollars, creating a new industry exceeding in value the wheat crop of the United States.

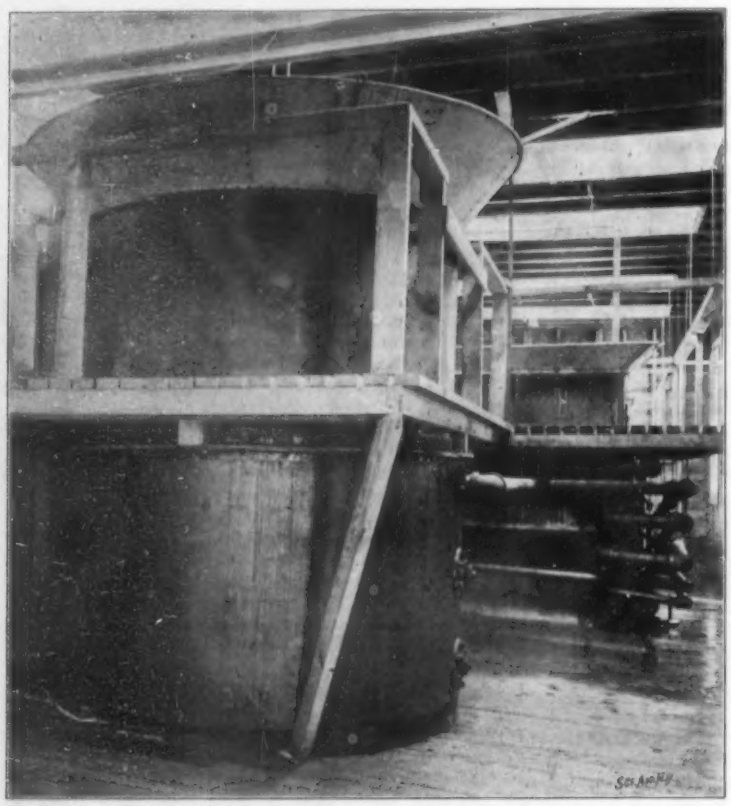


DRIED MILK BEFORE BEING GROUND INTO POWDER.

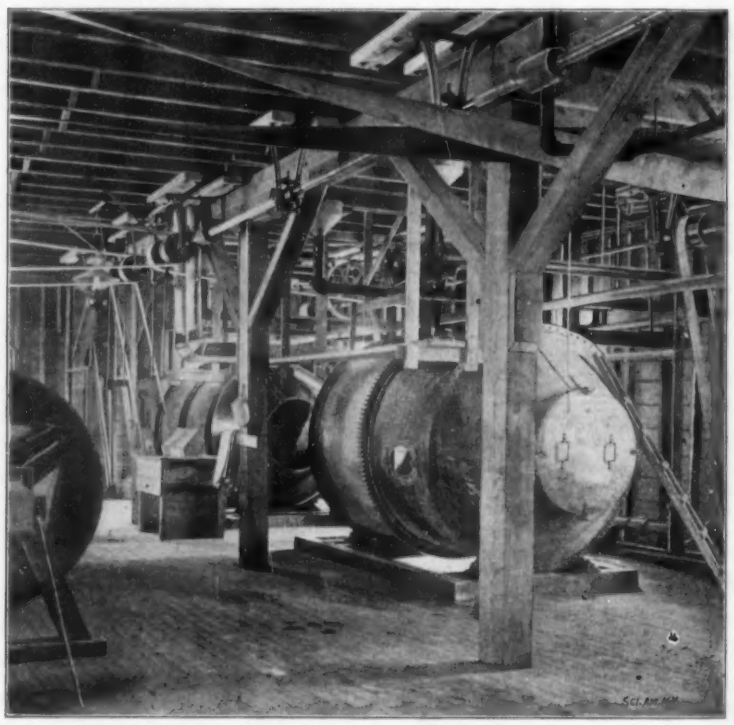
But even more than this it was realized that the recovery of the non-fatty solids of milk in a dry condition would furnish milk to the tropical regions where it was heretofore unobtainable; would permit an addition to the rations of the soldier and the sailor in the most convenient form, with the least possible waste; would be an invaluable addition to the hospital dietetics; would supply an important factor in the treatment of diabetes, Bright's disease and other similar maladies; would furnish properly balanced rations to all classes at the cheapest rate, and would be a general boon to humanity in maintaining vigorous normal health, allaying suffering, promoting longevity and reducing infant mortality.

The process of development was slow; difficulties were presented at every turn, some of which for a time seemed insurmountable. But after nearly three years of labor and the expenditure of nearly $100,000 success crowned the efforts and powdered milk or Nutrium, as it is known, became a reality, and its manufacture is now a flourishing industry.

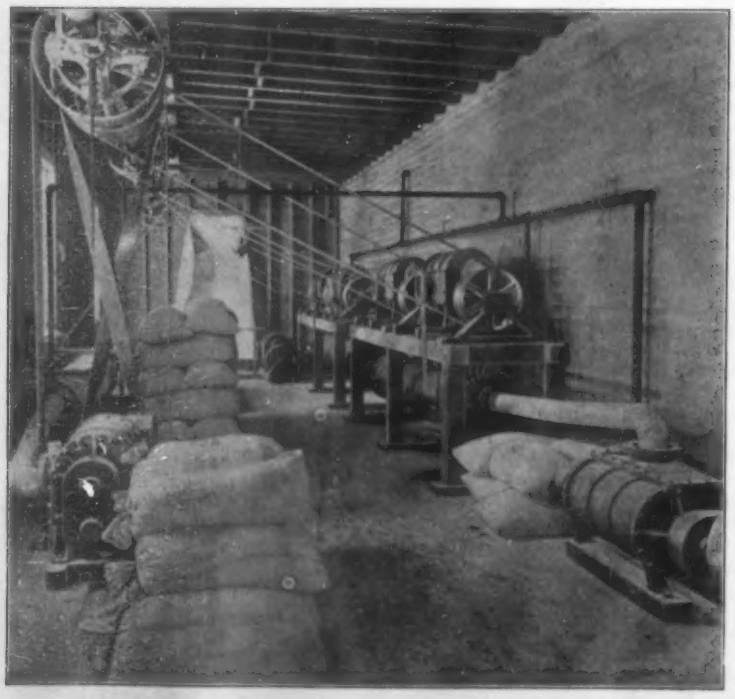
The views herewith presented show the various stages through which the milk passes at one of the three mills of the National Nutrient Company, pre



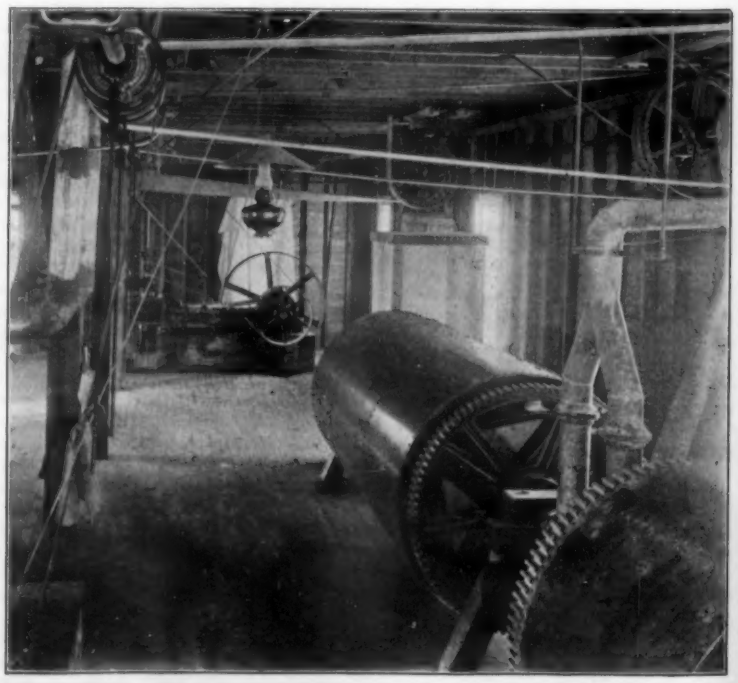
CONCENTRATING ROOM, SHOWING STERILIZING VAT.



GRANULATING ROOM, SHOWING ROLLER DRUMS.



BLOWERS AND AIR STERILIZING APPARATUS



GRANULATING ROOM, SHOWING DRIER DRUMS.

paratory to its shipment to the Jersey City, N. J., mill of that concern, where it is ground, bolted and packed. In this plant there are two of the largest pebble mills in the world used in grinding the dry lumps. The product in appearance resembles fine wheat flour, and is packed suitably for the safe transportation to all climates.

In one view is shown the copper tin-lined concentrating vessel. The milk is pumped into the large round copper vessel, where it is agitated and heated by sterilized air blasts preparatory to its being pumped into the four rectangular concentrating vessels. These concentrating tanks are provided with a circulating medium of hot water surrounding them and coils in their interior. They are also provided with pipes and fan-shaped nozzles for the introduction of sterilized air below the surface of the milk. This air is under a pressure and is allowed to escape when the tanks are charged with milk and causes the water vapor to be driven off. The milk here has a violent rolling motion, greater than if boiling. The milk is thus reduced to about one-sixteenth of its volume. As the product becomes concentrated the temperature is lowered. The opening of a valve permits the mass to fall into the large roller drums with tapered ends, shown in another cut, and which are located on a lower floor. These roller drums are tin-plated and are perfectly smooth on the inside with cone-shaped ends. An air blast is then introduced into the head of the drum. The latter revolving about two turns per minute, carries the pasty product up on its side, and as it approaches the top it falls back through the dried atmosphere, the air thus carrying away the moisture. This paste soon becomes too heavy to be carried up by the revolving of the drum and rolls into a large mass, the cone-shaped ends causing it to move unequally and twisting and grinding it into small particles. These are then conveyed to the drier drums, where the desiccation is completed.

These drier drums have a novel construction. Sterilized air is forced through a central shaft having lateral arms extending down into the mass, where the constant rolling of the drums exposes all parts to the desiccated air. When the product is bone-dry it is then conveyed to a grinder, which brings it to about the consistency of corn meal, and it is then packed.

The proper office of powdered milk is not so much to act as a food of and by itself, but as a means of cheaply furnishing other foods with the proteids in which they are deficient, and thus restoring the balance which is essential to health.

The successful reduction of milk to the form of a powder is an achievement of much importance to the bakers, particularly those engaged in the business in a large way. They are enabled to secure their milk supply without any possibility of interruption and at a much lower cost. This latter is due to the fact that the dried milk can be shipped so much more economically than the milk in its original form. A five-pound box can be shipped at a small fraction of that of its equivalent of whole milk and can be mixed as desired. The losses in the handling of fresh milk around the bakery are very great. Much is consumed by the men handling it, a great deal is wasted and considerable is spoiled by being improperly cared for.

A NEW CURIOSITY AT THE NEW YORK AQUARIUM.

Considerable excitement has been caused in the vicinity of this city over the rumor that a live "sea-serpent" had been captured and placed on exhibition in the Aquarium. The crowds which thronged the Battery with the expectation of seeing a hideous, green-eyed monster of the dime-novel type have invariably returned disappointed and disgusted. Their reports have belittled the importance of the specimen, and given the general impression that the whole story is a fraud. This is unfortunate, for the creature is, indeed, a very rare specimen, never before having been seen in captivity.

It has been identified as belonging to the moray family, and is known as the *Channomuraena vitata* (Richardson). That the fish is indeed a rare specimen may be gathered from the fact that there is but slight mention of such a species, and the only authentic record is that of the ichthyologist Richardson, who discovered the fish in 1844 in the neighborhood of Cuba, and gave a fair description of it.

The specimen has a skin of warty appearance, chocolate brown in color and striped with yellowish bands and spots. The tail is slightly flattened and bears no sign of a fin, nor can any fins be found on its body. In this it differs from all other morays, which have a fin extending the full

TREE SHATTERED AT THE BASE BY LIGHTNING.

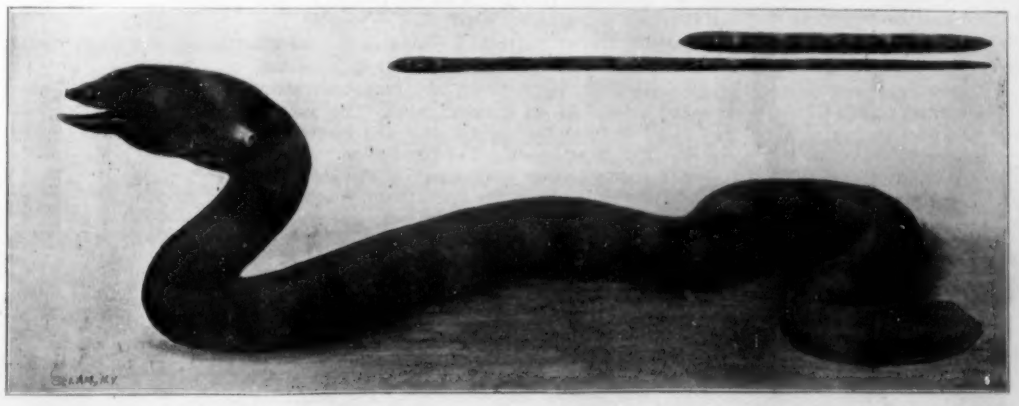
length of the back. The head also is very different, being broad and flat, while the common species of moray have a deep and narrow head. Its method of breathing, however, is identically the same as that of the other species. It is provided with the gill pockets which are characteristic of the family. In general appearance and manner of swimming the fish is snake-like in the extreme. When extended to its full length

HEAD OF THE EEL RECENTLY BROUGHT FROM BERMUDA TO THE NEW YORK AQUARIUM.

it measures just about 6 feet; however, it often draws itself in to a length of about 4 feet.

The story of its capture is quite amusing. The eel was discovered by three negroes who were fishing about seven miles northeast of Bermuda. The water at this point suddenly deepens from 11 fathoms to over 200. From this it is supposed that the moray is a deep-sea fish which by chance worked its way up from the deep water to the fishing banks. At all events, no such creature had ever before been seen in the vicinity of Bermuda within the memory of the oldest living inhabitants, and the catch so frightened the drunken fishermen that two were rendered helpless by their superstitious fears, while the third, immediately sobered, drew in the line and landed his prize. When the men reached shore the moray was deposited in a tide-pool for safe keeping. There chanced to be a hole in the coral bottom of the pool, and eel-like the creature crawled into this as far as it could, in an endeavor to conceal itself. When the negroes next visited the pool only two feet of eel could be seen, and, frightened beyond reason at the apparent contraction of the fish, they were glad to give it away to Prof. Charles L. Bristol, of New York University, who is in Bermuda gathering specimens for the New York Aquarium.

The moray seems to be doing well in its new quarters, and it is hoped that it will live. As yet the fish has eaten nothing, though constantly tempted with bits of codfish, on which the other morays thrive. This, however, is not an alarming symptom, but rather a characteristic of the moray family, for these fish often abstain from food for weeks at a time.



REMARKABLE EEL AT THE NEW YORK AQUARIUM (CHANNOMURAENA VITATA). WHEN STRIKING ITS PREY THE EEL IS ELONGATED AS SHOWN ABOVE.

A PECULIAR LIGHTNING-SHATTERED TREE.

The illustration shows the effects of a stroke of lightning on a tree located near Plymouth, Conn., which occurred in April, 1902. From the peculiarities observed it is believed this tree may have been shattered by an upward discharge.

Our correspondent states that the splinters were thrown away from the root of the tree and the body badly splintered, but the top of the tree untouched; but one limb about ten feet above the highest splinter on the tree is broken off about three feet from the tree.

On the opposite side of the tree there was a deep furrow plowed in the ground from the root of the tree toward a low swampy spot, as though the lightning may have come from this damp ground to the tree. The earth and leaf mold from this furrow were thrown as widely as the splinters, and the dark spots on the upper right-hand side of the picture are pieces of the leaf mold lodged on the branches of the surrounding trees.

It is certainly a very peculiar effect of the work of lightning, and would apparently lend color to the theory that it was caused by an upward stroke. Generally, however, a wet soil is regarded as a good conductor, and the track observed going toward the pond would indicate that the stroke descending might have struck the center of the tree first, and followed the easiest course to the pond.

Bonus for Gold-Saving Appliances.

According to Mining and Scientific Press, a bonus of £2000 ($10,000) is offered by the government of New Zealand to any person who, before the first of January, 1904, shall invent appliances to successfully save gold from black sands in New Zealand. It is a condition of the offer that the invention shall, in its main features, differ from all machinery and appliances at present in use for the saving of gold, whether coarse or fine. It shall be readily transportable from place to place, and shall be capable of utilizing local water for all its requirements. The invention must be capable of treating not less than 30 cubic yards an hour of black sand or any coarser material up to a diameter of 4 inches, and it must be capable of treating such material profitably where there is not more than a value in gold of 3d. (6 cents) per cubic yard, not less than 80 per cent of the gold contained in the material to be recovered by the machine. No bonus to be paid until the invention has been continuously worked for not less than six months, and it shall during that period have treated not less than 100,000 cubic yards of material, working three shifts a day. The bonus will be paid on the certificate of an officer that not less than twenty persons other than the applicant for the bonus are successfully working the invention. Any person who receives the bonus shall not be allowed to take out patent rights in New Zealand for his invention.

Patent Department

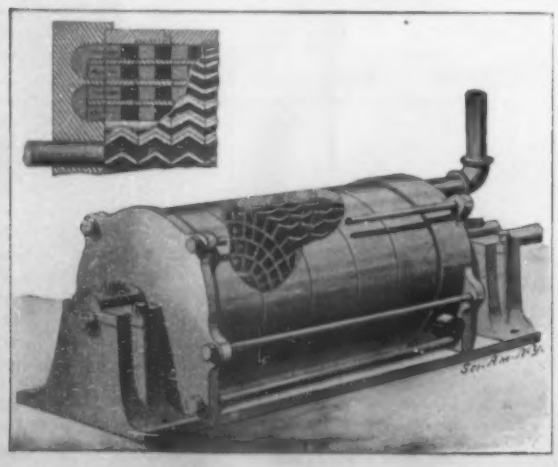
OIL-CAN.

By a novel construction of parts the oil-can here illustrated is made to forcibly and copiously eject oil upon flexing its bottom diaphragm. The can, which is similar in shape to the ordinary oil-can, is provided with a false bottom to which are secured two tubes; the longer tube, which is central, projects into the spout of the can, while the shorter tube opens near the top of the body portion. At the base of each tube is a valve, that in the longer tube opening upward, and the valve in the shorter tube opening downward into the bottom compartment. A nipple is removably fastened in the wall of the body near the top. An inwardly-opening valve in this nipple forms a passage for the admission of air at atmospheric pressure. The oil, filling the body and flowing through the shorter tube, passes into the compartment below the false bottom. Now, when the bottom of the can is flexed inwardly, the valve of the shorter tube will seat, but that of the center tube will open, and the oil will be forced out through the spout. As the bottom returns, because of its resiliency, to its normal position, this latter valve will seat, while that of the shorter tube will open, allowing a fresh supply of oil to flow into the bottom compartment. As the oil is removed from the body portion, air takes its place by way of the valve in the nipple. On outward pressure, however, this valve closes. To fill the can the nipple is removed, thus affording an opening through which the oil may be poured. The device has recently been patented by Mr. Thomas Vojta, of Mound City, So. Dak.

IMPROVED OIL-CAN.

NEW TURBINE ENGINE.

Our illustration shows a new turbine engine of novel construction which has recently been invented by Mr. William D. Linscott, of Piedmont, So. Dak. The inventor has built a toy experimental engine of this design, which weighs but 63 pounds and which, under 40 pounds' pressure, has developed enough power to run a small lathe, a grindstone, a sawmill and several other devices. The construction is such as to require little or no attention, for there are no complicated running parts to cause wear, and require packing to make them steam-tight. The steam is economized and continually reused. The simple construction of the engine is clearly shown in the engraving. The cylinder or casing is made up of a number of annular sections which are held together by the tie-rods that bind the cylinder heads together. Each cylinder section is provided with a honeycombed web formed by annular series of ribs or partitions separated by circular partitions. These honeycombed webs are formed at one side of the sections, leaving cavities for the reception of the piston webs. The latter have a construction similar to that of the cylinder webs, the circular partitions being respectively in registry with each other. Steamtight connection can be made between them by providing the circular partitions of the pistons with ribs to fit loosely in corresponding grooves in the edges of the cylinder partitions. Each piston is provided with an elongated hub, these hubs being keyed to the shaft and projecting under the cylinder webs so as to give them support. The feed-pipe at one end of the engine communicates with an annular cavity in the cylinder head. This feeds steam to the innermost series of openings in the cylinder and piston webs. Reference to the illustration will show that these openings are in line with each other and form steam passages extending completely through the engine. The steam flowing into the innermost passages enters an annular return port in the opposite cylinder head. This leads the steam back to the next outer series of steam passages, whence it is again returned and passed back and forth through the successive series until the outermost passage has been traversed, whence it passes out through the exhaust pipe. The ribs or veins which form the side walls of the steam passages are V-shaped, as clearly shown in the small detail view. Now it will be seen that the steam acting on the veins of the piston webs will give them a rotary motion, while the veins of the cylinder frame act continually to deflect the steam and re-direct its flow against the piston webs. The steam has a continuous course through the various passages of the engine, and thus its entire energy is made use of to drive the pistons continuously in one direction. These in turn impart movement to the shaft. Obviously any number of annular steam passages can be formed in the engine, thus increasing its power.



NEW TURBINE ENGINE.

ELECTRIC LAMP.

In order to increase the illuminating power of an incandescent electric lamp, a California inventor

A NEW INCANDESCENT LAMP.

forms the bulb with an interior tube open at one end. The tube and bulb are so connected that the vacuum is not destroyed and that a brush can be exerted in the tube to appy silver to the walls in order to form a reflector. The filament is coiled around the tube, so that a maximum amount of light-producing surface is provided.

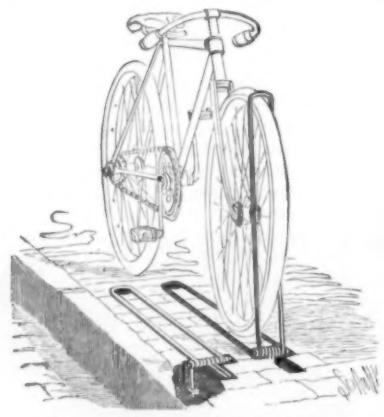
A Self-Lighting Cigar.

An inventor, who is evidently wearied of the many fruitless attempts to light a cigar in a windy street, has invented a combustible tip, which is intended to do away with the use of matches. The tip is composed of a mixture of ground glass, saltpeter, potassium chlorate and gum arabic. This mass is molded into a cap on the end of a cigar, and a frictional igniter, such as that used on the tips of matches, is placed on the surface of the cap. When the igniter is scratched, the cap burns freely and cannot be extinguished by an ordinary wind. The combustion fuses the ground glass and renders the cap incandescent. The fused glass forms an airproof cover on the end of the cigar and prevents any of the fumes from entering the tobacco, so that no unpleasant taste results.

A process has been discovered in France by which garbage is converted into briquettes, which consists in mincing the refuse from abattoirs, fish markets, etc., straw, paper, etc., and adding tar and naphthalene. The mass is then mixed in a kneading apparatus, dried, and pressed into briquettes. The briquettes have a slight odor of gas, burn brightly and engender heat slowly, it is claimed, and with a more highly perfected method of manufacture they will produce less ash, and the heat-producing qualities will be about the same as those of common coal. They will also possess the advantage of burning slowly and developing no smoke.

BICYCLE TANDS.

Most bicycle stands now used on sidewalks are bulky contrivances, occupying considerable space and presenting annoying obstructions to pedestrians. We show here a stand of very simple construction which, when not in use, folds down automatically into the sidewalk, thus offering no obstacle to foot travel. The stand consists merely of a rod bent to an elongated U-shape, and designed to engage the sides and upper surface of a bicycle wheel. The two legs of this stand are coiled at their lower ends about a bar secured in a recess in the sidewalk. The sidewalk is also provided with a channel for receiving the device when folded. The ends of the rod, extend outward, and form anchors to prevent the device from swinging too far rearward. These ends may be brazed together,



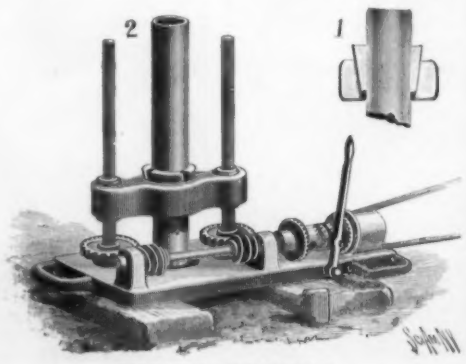
A CONVENIENT BICYCLE STAND.

and when the device is turned up in operative position, the ends will engage a metal plate secured to the wall of the recess, thus holding the stand at a slight forward incline, so that when the wheel is removed, it will fall by gravity to its position in the sidewalk. The channel can be easily formed in a wooden or stone sidewalk by the use of suitable tools, or if a concrete walk is used, the simplest way of forming the channel is to press the rod into the concrete while the material is still wet. The inventor of this simple stand is Mr. Louis H. Knoche, San Jose, Cal.

PIPE PULLER.

A patent has recently been granted to Mr. James A. Haire, of Weyauwega, Wis., for a pipe puller of improved design. The device, which is portable, is so constructed that power may be taken from a driving belt or chain and communicated to the lifting screws with the least possible amount of machinery. The pull on the pipe is straight, and obviates any tendency to torsion or wind on the crosshead.

The device as illustrated comprises two parallel upright screws mounted to turn in a baseplate and connected by a crosshead provided with nuts which travel along the screws. A hole is provided in the baseplate, through which the pipe to be pulled passes; the pipe also passes through a taper opening in the crosshead, to which it is secured by tightly-driven wedges. The screws are provided with worm gears, which mesh with worms on the driving shaft. It will be noticed that the screw on the left has a right-hand thread, and that on the right has a left-hand thread; the pitch of the worms also is such as to turn the screws in opposite directions. The object of this arrangement is to obviate any tendency to torsion or wind in the crosshead, while the right-hand or left-hand worms tend to balance the end-thrust of the driving shaft, thus making a pipe puller that is light in weight, compact and very durable, and one which will easily do the required work. A reversing



PORTABLE PIPE PULLER.

mechanism is provided on the driving shaft, which consists of a large bevel gear and two bevel pinions loosely mounted on the shaft, one of these pinions being secured to the driving pulley at the right. The pinions are each provided with clutch faces, which are adapted to engage the teeth of the double clutch mounted to slide on a feather of the driving shaft. Either right-hand or left-hand motion can thus be imparted to the screws by sliding the clutch into engagement with one or the other of the bevel pinions. This reversing mechanism is designed for use with a horse power or engine that cannot reverse the motion. Handles are secured to the base, enabling the device to be readily moved from place to place whenever desired.

Brief Notes Concerning Patents.

Andrew Phillips, of St. Louis, Mo., has invented an electrical sweating robe, comprising an outer layer and an inner layer of equal size. These layers are secured together by a seam around their edges and by a number of seams extending longitudinally. These longitudinal seams divide the robe into columns wider at the head than at the foot. An electrical heat-generator wire of zigzag form is arranged within columns; the terminals of the wire being at the columns at the same end of the robe.

The Armour Packing Company, of Chicago, has acquired the patents of a new canning process, the invention of Mr. Maconohie, the English member of Parliament for East Aberdeenshire, Scotland. The salient characteristics of this process are the elimination of all solder in the canning of preserved provisions, the obviation of all danger of ptomaine poisoning, while canning can be carried out more expeditiously and economically than with any other system at present practised.

I. G. Waterman, a millionaire resident of the Montecito Valley of California, has invented an electrical device for controlling the spigots of the bathroom by a touch button in the bedroom. By this means one can reach out from the bed and turn the water into the tub, and when the latter is filled the flow is automatically shut off. With an installation of this character in the house one is enabled to stay in bed until the bath is entirely ready, and then jump almost from under the covers into the water.

For inventiveness the town of New Britain, Conn., apparently takes the palm. Since the United States patent laws have been in existence, 1447 inventions have been patented by 344 New Britain citizens. For ten years one patent was granted annually to every 367 inhabitants of the town. The man who heads the list for the number of patents taken out is Justus A. Trout. From his prolific brain 121 patented inventions have sprung. Another man, George E. Adams, has patented 66 inventions. A third inventor, Thomas E. Corscaden, has patented 51 devices. The fourth place in the list is occupied by Henry G. Voight, who has taken out 44 patents on inventions.

A new process for the manufacture of artificial marble has been patented by S. Sborowitz, of Berlin. The new product is said to be particularly fine and very cheap. Asbestos, dyeing materials, shellac and ashes are pounded into a stiff mass, and then subjected to high pressure. The resulting mass is surprisingly firm and tough, not brittle, is very easily worked by means of tools, can be given a fine polish, and cannot be distinguished on a mere ocular inspection from genuine marble. As it does not break easily, it can be used in the shape of very thin slabs of little weight, and will be very useful for the manufacture of washstands, wall coverings, etc. Owing to its being much cheaper and more durable in contact with water than any other kind of artificial marble, this new material, which can be pressed into molds and given any shape desired, seems to have a promising future for the manufacture of a great variety of household goods and also insulators for electro-techaical purposes.

Two inventors who live in Stirling, Scotland, have invented a lifeboat which is intended to become automatically inflated when it is immersed in water. A spring is employed which is kept in a state of tension or compression by means of a strip or roll of paper, the tensile strength of which, as long as it is dry, is sufficient to maintain the spring in a state of tension or compression, but which, when it becomes wet by immersion in water, immediately loses its strength or rigidity to such an extent that it is ruptured by the energy stored in the spring. Thus is the spring set free. The release of the spring causes the production of a volume of gas from materials sufficient in quantity to give the appliance any flotation power required. The materials in question are inclosed, together with the spring, in a perforated metal case, secured in the appliance in any desired manner, but so that water can have access to the controlling strip, as soon as the appliance is thrown overboard. Gas can be produced by the combustion of cordite or ballustite.

Legal Notes.

TWO GREAT IRON COMPANIES IN COURT.—The Supreme Court of the United States has handed down a most important decision in which the Carnegie Steel Company and the Cambria Iron Company are concerned (22 S. C. Rep. 698). The Carnegie Company sought to recover against the Cambria Iron Company for an infringement of letters patent issued June 4, 1899, to William R. Jones for a method of mixing molten pig metal.

The Court broadly decided that a process patent is not anticipated by the mechanism which might with certain alterations be adapted to carry out that process, unless such an application would have occurred to one whose duty it was to make practical use of the mechanism described.

The process claim of the Jones patent for mixing molten pig iron covered a method of securing great uniformity in chemical composition, and of avoiding the necessity of remelting before further treatment in converters. The dominant idea was the permanent retention in a covered reservoir of so large a quantity of the molten metal as would absorb variations of the product from the blast furnace received into it and discharged from it into the converters. That claim, the Court held, was not anticipated by prior patents which contemplated the storage or mixture of the reservoirs of molten metal from blast furnaces for use in casting or converters. For in none of these patents was the retention of a quantity of the molten metal recognized as essential. Nor was the invention anticipated by the practice in steel works of mixing remelted pig iron from cupola furnaces in receiving ladles, in which a considerable residue was generally maintained.

The specification of Jones' patent stated that the primary object of the invention was to render the product of steel work uniform in chemical composition. The construction of Jones' process claim as covering a method for avoiding abrupt variations in the chemical constituents of molten pig metal before further treatment in converting it into steel, seems to conflict with this statement of the object of the invention. But the Court held that such a construction was not inconsistent with the specification.

In his patent Jones specified neither the size of the reservoir nor the amount of metal to be left therein, in carrying out his process of mixing molten pig iron so as to secure greater uniformity of chemical composition. But the specification called for a reservoir of any convenient size, "holding say, 100 tons of metal," with the bottom of the discharge spout two feet above the bottom of the vessel in a 100-ton tank, "and more or less according to the capacity of the vessel," for the purpose of leaving a considerable quantity remaining and unpoured with which the fresh additions may mix. In the Court's opinion, the height of the permanent retention in a reservoir of a large quantity of molten metal as a basis for unification of the product of blast furnaces received into it, is sufficiently disclosed.

In order permanently to retain in his covered reservoir a quantity of molten metal sufficient to absorb the variations of the blast furnace products received into it and discharged from it into converters, Jones used a covered refractory-lined and turtle-shaped tilting vessel of about 300 tons capacity. By not allowing the vessel to tilt beyond a certain point gaged by a chalk mark, it was possible to retain in the vessel about 175 tons of molten metal. Before Jones' invention there had been used an intermediate, uncovered receiving-ladle for cupola metal, which held considerably more than the amount of metal necessary to charge a converter. It was the Court's opinion that such prior use was not an anticipation of Jones' invention. The Circuit Court had held with the Carnegie Company; but its decision was reversed by the Circuit Court of Appeals. On a writ of certiorari the Supreme Court reversed the decision of the Circuit Court of Appeals.

TESLA'S PATENTS AGAIN IN COURT.—In a suit brought by the Westinghouse Electric Manufacturing Company against the Royal Weaving Company, of Pawtucket, R. I., the Tesla patents were again sustained. In the opinion it is stated that the defendants relied on two French patents to make out their case of non-infringement, contending that these patents disclosed what was not before the courts in the Granite case, namely, that two single-phase synchronous motors could be coupled together, as, for example, by having their armatures mounted on the same shaft; and that these two motors might be run each by its own circuit of alternating currents. The Court held that these patents, even if produced in the Granite case would not have affected the decision as to the nature and novelty of Tesla's invention; and as to the validity of the patents in suit, the Court decided that the question of infringement seems to be substantially determined by the prior decisions.

THE NORTON FEED-SCREW PATENT CONSTRUED.—On March 8, 1892, Wendell P. Norton was granted a patent for a feed to be used on screw-cutting engine-lathes, whereby it was possible to change the speed of the feed-screw rapidly, according to the requirements of the screw to be cut. Two sets of devices were described. One consisted of a series of three interchangeable gear-wheels of varying diameters, arranged at one end of the machine, speed variation being secured by changing their relations to one another—a result that could be obtained only when the machine was at rest, since nuts would first have to be unscrewed, and the wheels removed and placed on different spindles. By such changes, three different speeds could be imparted to the feed-screw. The other set of devices consisted of a series of twelve gear wheels of varying diameters, arranged in steps. By means of a hand-lever and connecting mechanism, one or other of these could be brought into engagement while the machine was moving, and thus twelve speeds could be imparted to the screw-feed. An examination of the prior state of the art, which was made by the Court in the case of the Hendey Match Company vs. Prentiss Tool and Supply Company (113 Fed. Rep. 592), showed that the patentee was not a pioneer. "The case is one, therefore, in which the particular combination of parts and details secured to the inventor by his patent is to be conformed to the self-imposed limitation in the claims, and nothing can be infringement which does not fall within the terms the patentee has chosen to express his invention." The bill in the case was dismissed, because the defendants' combination changed the location of the gears from the feed-shaft to the counter-shaft.

SCIENTIFIC NAMES AS TRADEMARKS.—In the case of Searle & Hereth Company vs. Warner (112 Fed. Rep. 674) the use of scientific names as trademarks was fully discussed by the Circuit Court of Appeals for the Seventh Circuit, Mr. Justice Groscup delivering the opinion of the court. The substance of the decision handed down is, in brief, that after both pancreatin and pepsin had been discovered and named, their effects as aids to digestion had been investigated, and the results of such investigation had been published to the world for several years, the manufacturer of a digestive preparation could not adopt "pancreopepsin," a combination of such names, as a trademark, and thereby prevent the use of these names by other manufacturers of similar digestive preparations. The specific word "pancreopepsin" is in a sense artificial. As the Court pointed out, it was doubtless coined to some extent through the ingenuity of the appellee. In another case it might even be made the basis of injunction against unfair competition. But the Court held that the appellee could not appropriate similar words, simple or compound, that grow out of the medical nomenclature relating to pancreatin and pepsin, and that such right of appropriation does not at any rate extend to the word "pancreopepsin," which was the name applied to the digestive preparation of the appellee.

One of those incomprehensible bills which are often enough presented to the House of Representatives seeks to extend the term of George B. Simpson's patent for an improvement in insulating submarine cables. Under ordinary circumstances the reason for the extension of a patent's term can be readily understood. Often enough seventeen years pass without an invention's coming into actual use. In the present case, however, the patent was originally granted on the 21st of May, 1867, and, therefore, expired fully nine years ago. It would seem an injustice to those manufacturers who may have begun the making of Simpson's appliances after the expiration of the patent to restrain them now, and to curtail for seven years a business that they may have built up. Of course there is no chance of its receiving favorable consideration.

VALIDITY OF DESIGN PATENTS.—In the matter of the Bevin Brothers Manufacturing Company vs. Starr Brothers Bell Company (114 Fed. Rep. 362) the United States Circuit Court for the District of Connecticut held that the fundamental question in determining the validity of a design patent is whether the inventive faculty has been exercised to produce something which is original and pleasing to the eye; for in design patents the test of identity on questions of anticipation and infringement is the eye of the ordinary observer. In determining this question, the Court may avail itself of such common knowledge as the general public may possess.

The application of the Allgemeine Elektricitäts Gesellschaft to the German patent office for the annulment of the Braun wireless telegraphy patent has been refused with costs.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

COMBINED SEEDER, FERTILIZER-DISTRIBUTER, AND CULTIVATOR.—A. CRAVOTTO, Montevideo, Uruguay. The invention relates to agricultural machines and provides a new seeder and fertilizer distributer designed for sowing small seeds, such as clover, lucerne, linseed, wheat and the like, at the same time fertilizing the soil uniformly to insure proper growing and ripening of the plants.

SILO.—A. F. WALLIHAN, Reliance, Va. It is necessary to the attainment of the best result in preservation of fodder that the vertical wall of a silo shall have no acute angles or corners, and therefore a circular form is the ideal one. This form is, however, difficult to construct and also expensive. Mr. Wallihan has devised a silo of polygonal shape which closely approximates the circular. Cement-holding laths are applied thereto in such a manner that the cement does not become cracked or detached by vertical expansion of the silo wall.

GEAR-TRANSMISSION.—J. SUCHY, Littleheart, No. Dak. This gear transmission is designed for use on self-binding harvesting machines. It is composed of but few parts not liable to get easily out of order, and is arranged to permit the operator to conveniently throw the driving gear quickly in and out of mesh with the driven gear, and to securely hold and lock the driven gear in position whenever desired.

Apparatus for Special Purposes.

APPARATUS FOR THAWING FROZEN GROUND.—G. R. CLARKE, Dawson, Canada. The invention relates to mining in northern countries, and its object is to provide certain improvements in apparatus for thawing frozen ground, whereby hot water is readily and cheaply furnished. In the case of hot, hydraulic mining the hot air and vapors in the drift are removed therefrom and utilized in the furnace for heating the water.

ELEVATED-CABLE SYSTEM OF TRANSPORTATION.—T. ALEXANDER, Brookhaven, Miss. The system is employed in transporting logs, dirt, coal and other freight in which a truck runs upon a cable attached to horizontal arms or brackets affixed to posts. The invention provides improved means for supporting and locking the cable, also means for raising the cable to cause propulsion of the freight by gravity and for allowing slack of the cable at any desired point for the purpose of taking up or arresting and releasing the freight when at the end of its transit.

SUPPORT FOR OVERHEAD CARRIERS.—T. ALEXANDER, Brookhaven, Miss. This invention provides improved frame support for the track or wire rope of an overhead carrier. One of the chief difficulties in constructing such carriers is the provision of supports that shall have due strength, rigidity and durability without involving too great a cost. Such a support has been designed by Mr. Alexander.

Hardware.

SPIRIT-LEVEL.—S. E. ROE, New York, N. Y. The invention relates to a means for mounting and carrying spirit-tubes for use on levels and plumb-rules employed by mechanics in various trades. The spirit tubes are secured to the straight edge of a plumb-rule and by means of a cruciform arrangement, vertical, as well as horizontal attachments may be secured.

Miscellaneous Inventions.

TROUSERS CREASER.—H. A. BROWN, Macon, Ga. Dr. Brown is the inventor of a new device for creasing trousers. The device is very simple and light, so that it may be easily carried in a valise and will occupy but little room therein. The construction is such as to permit the creasing of the trousers over night, when it is desired to use them in the day, or they can be creased at other times in a few hours, as may be desired.

SPRING-CLAMP FOR LENSES OR THE LIKE.—E. L. LEMBKE, New York, N. Y. Every wearer of eyeglasses wishes occasionally that his pince-nez were spectacles. Spectacles stay on however violent one's exercise, however warm the weather. Mr. Lembke has invented a device for transforming eyeglasses into spectacles. Temple attachments are provided which can be quickly and easily clamped onto the eyeglasses to produce the required spectacles.

PILLOW-SHAM HOLDER.—TILLY BAMBAUER, Volta, Cal. The invention provides means whereby the pillow-sham may be held properly in every respect and yet the holder made readily applicable to any bed without marring or injuring its finish.

DEVICE FOR UNROLLING CLOTH OR OTHER FABRICS.—H. L. ROSENTHAL, New York, N. Y. This device, which is of simple construction, is provided with a revoluble platform and means for controlling the movement of the platform, along with means for receiving and sustaining a roll or bolt of cloth removable from the platform, yet capable of ready interlocking engagement therewith.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

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Marine Iron Works. Chicago. Catalogue free.

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"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 2868.—For manufacturers of milk condensers.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 2869.—For dealers in mailing cases, labels, advertising cards, etc., for a patent medicine.

FOR SALE.—Patent carbonating machine. F. W. Z., BOX 773, N. Y.

Inquiry No. 2870.—For dealers in wood screw-brackets for glass insulators for electric purposes.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 2871.—For blocks of hard cardboard or soft wood ¾ inch square by ¼ inch thick.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 2872.—For small steam slidevalve engines 1½ x 3 or 2 x 3 inches.

We make anything in sheet metal, any shape. Estimates free. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 2873.—For metal door plates, numbers, etc., and machinery for making same.

We design and build special and automatic machinery for all purposes. The Amstuts-Osborn Company, Cleveland, Ohio.

Inquiry No. 2874.—For manufacturers of machines for gathering nails in large quantities.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 2875.—For dealers in German silver wire, tube and plate, hard and soft.

Automobiles built to drawings and special work done promptly. The Garvin Machine Co., 149 Varick, cor. Spring Streets, New York.

Inquiry No. 2876.—For an oil burner adaptable for furnace, heating and cooking stoves.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2877.—For dealers in rubber stamp-making outfits.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2878.—For dealers in metal specialties, novelties and articles of merit.

INVENTIONS DEVELOPED.—Designing and building of labor-saving machinery and general engineering. L. J. Zimmerman, Elect. and Mech. Engineer, 106 Center St., N. Y.

Inquiry No. 2879.—For manufacturers of hydraulic lifting jacks.

An experienced business man desires correspondence with party requiring means for developing, manufacturing or marketing a patented specialty of merit. Address Specialty, Box 773, New York.

Inquiry No. 2880.—For parties to make small wooden blocks of different shapes.

WANTED.—Experienced master mechanic for blast furnaces. Apply immediately, stating in detail experience, references, age, salary expected and earliest date can commence. Address "Blast," Box 773, N. Y.

Inquiry No. 2881.—For manufacturers of sheet aluminium.

WANTED.—A large correspondence school desires the spare time services of an experienced electrician to prepare and write a mail course on electrical engineering. In writing state qualifications, experience and references. J. H. Bowen, Box 233, Scranton, Pa.

Inquiry No. 2882.—For dealers in or makers of aluminium tubing.

Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 2883.—For manufacturers of lawn mowers in the United States.

Patents developed and manufactured, dies, special tools, metal stamping and screw machine work. Metal Novelty Works Co., 43-47 S. Canal St., Chicago.

Inquiry No. 2884.—For full information from parties familiar with the destructive ravages of the teredo to piling.

Die work, experimental work and novelties manufactured. American Hardware Mfg. Co., Ottawa, Ill.

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Inquiry No. 2888.—For dealers in electric ceiling and desk fans.

Inquiry No. 2889.—For machinery for making horseshoe nails.

Inquiry No. 2890.—For dealers in small engine castings.

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Inquiry No. 2892.—For wholesale dealers in bamboo for use in the manufacture of furniture.

Inquiry No. 2893.—For makers of small go-cart wheels 6 inches high and rubber tires.

Inquiry No. 2894.—For dealers in articles for a street fair, such on rubber sandwiches, candy bag-pipes, etc.

Inquiry No. 2895.—For dealers in very thin sheet steel.

Inquiry No. 2896.—For dealers in thin brass called "band plating material."

Inquiry No. 2897.—For dealers in apparatus and chemicals used in the manufacture of incandescent mantels.

Inquiry No. 2898.—For manufacturers of spring motor ceiling fans.

Inquiry No. 2899.—For makers of small wool carding and spinning machines.

Inquiry No. 2900.—For makers of carpet-cleaning machinery.

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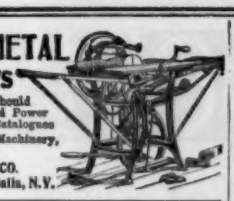

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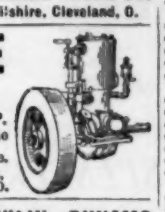

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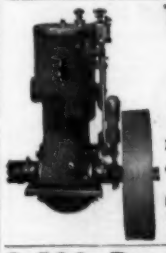

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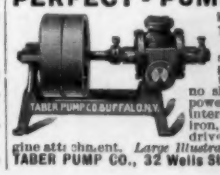

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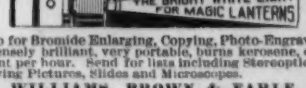

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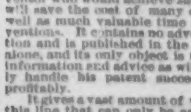

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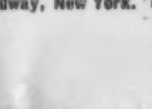

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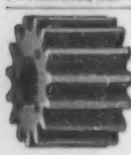

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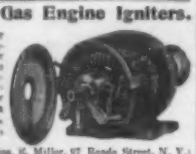

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AN ELEMENTARY TREATISE ON ALTERNATING CURRENTS. By W. G. Rhodes, M.Sc. London, New York and Bombay: Longmans, Green & Co. 1902. 8vo. Pp. xii, 211.

If ever an electrical book was needed, it is a clear work on alternating currents. Such a book Mr. Rhodes has endeavored to provide. The product of an instructor's labor, the book will probably be appreciated by students. The practical engineer will also find this book of service; for, without being the least ponderous, it gives him a simple and comprehensive treatment of any phase of the subject, which he may be at the time interested in.

PAPERS AND REPORTS RELATING TO MINERALS AND MINING. By Authority of John Mackay, Government Printer. Wellington, New Zealand. 1901. Pp. 36.

CONDITIONS OF CONTRACT RELATING TO BUILDINGS. By Frank W. Macey. London: Sweet & Maxwell, Ltd. 1902. 8vo. Pp. xix, 278.

Mr. Macey and Mr. Leverson have collaborated to produce a book that deals with the conditions of contracts and with agreements as applied to all classes of architectural work, and with the law generally in its relation to various matters embraced within the scope of architecture. The style of the book, although essentially legal, is nevertheless clear and readily understandable.

ON THE FUSION OF QUARTZ IN THE ELECTRIC FURNACE. By R. S. Hutton, M.Sc. From Volume 46, Part II., of Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Session 1901-1902. Manchester. Pp. 5.

THE COPPER HANDBOOK. A Manual of the Copper Industry of the United States and Foreign Countries. Vol. II. Houghton, Mich. Compiled and published by Horace J. Stevens. 1902. Small 8vo. Pp. ix, 416.

This second annual edition of "The Copper Handbook" includes new chapters on the history of the chemistry, mineralogy, and metallurgy of copper, and on the copper deposits and copper mines of the world besides those of the United States. In this respect it supplies information which may have been missed in the first edition. A considerable amount of new statistical matter has been added; and the tables given in the previous issue have been decreased in number, although increased in scope and value.

A B C OF ELECTRICAL EXPERIMENTS. By W. J. Clark. New York: Excelsior Publishing House. 1902. 16mo. Pp. 146.

Mr. Clarke writes in a way that will probably appeal to every boy who is at all interested in electricity. The apparatus which he describes is simple; and what he has to say, he says with a clearness that leaves nothing to be desired. The personal pronoun "I" plays a somewhat too important a part in his prefatory remarks. Six "I's" in the space of four lines assuredly transcend the limits of propriety.

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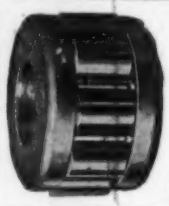

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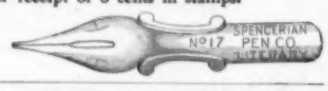

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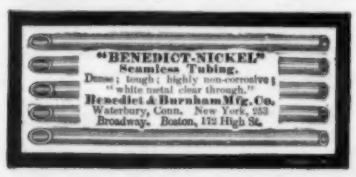

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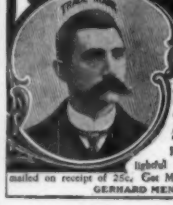

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(8634) C. W. B. asks: Please publish on what principle of hydrodynamics the ball nozzle works. A. The ball is held in the ball nozzle because there is more pressure on its outer surface than on its inner surface. Hopkins, in "Experimental Science," ($5, new edition shortly) gives the explanation for the ball held by air in a similar way that the stream of air adheres to and carries away the air in contact with the inner surface of the ball, thus reducing the pressure on that side, and producing a partial vacuum there. The external air therefore presses the ball into the stream of water and spreads the stream.

(8635) G. K. asks: Do you know of any means whereby green leaves, such as ferns, smilax, or such as have very thin leaves, can be dyed or dipped in some solution which will keep them near their natural color and also keep them from falling to pieces? A. Plants may be dried without destroying their natural colors in most cases by placing them under pressure between sheets of blotting paper, and frequently changing the papers. The leaves do not fall off with this treatment. 2. Do you know of any means whereby small flowers can be dyed white so as to preserve them to be used commercially? A. Flowers can be bleached to whiteness by sulphur fumes in the same manner as straw is bleached in making hats. We do not know any means of dyeing them white, so as to preserve their beauty of form and appearance.

(8636) B. K. asks: What is the safe gap figured out between line and ground in lightning arresters for 5,000 volts A. C., 2,700 A. C. and 1,000 volts A. C.? A. Foster's "Pocket Book for Electrical Engineers," price $5, gives the data for the various lightning arresters. Those of the General Electric Company for 1,000 volts are given as having two metal cylinders 2 inches in diameter and 2 inches long, separated by an air gap of 1-32 inch. A low non-inductive graphite resistance is inserted between the arrester and the ground. The arrester for 2,000 volts is made with two spark gaps of 1-32 inch each and a non-inductive resistance. For higher voltages the 2,000-volt arrester is used as a unit, and enough of these are placed in series to make the necessary spark gap.

(8637) B. Y. G. asks: 1. Would you please inform me the exact solutions, in the metric system, for a liter bottle battery of bichromate of potash, liter battery of sal ammoniac, of a liter Leclanche? A. There are many different formulæ for bichromate of potash solutions for battery use. They may be said to be about as follows: Water, 100 parts; bichromate of potash, 10 to 20 parts; sulphuric acid, 10 to 25 parts. All parts by weight. The batteries using sal ammoniac generally employ a saturated solution. 2. About how much a Ruhmkorff coil giving a 6-inch spark would cost? A. They are quoted from $175 to $70 by different makers. 3. How big a spark is necessary (and how many volts) to see the bones in a hand by an X-ray globe, and how many liter single-liquid bichromate of potash batteries would be needed to make the spark? A. A 6-inch coil will penetrate all but the thicker portions of the body. Four to six bichromate cells should furnish current enough to run it.

(8638) K. K. asks: 1. What is the temperature of steam in the boiler at 80 pounds pressure, and the temperature of the fire underneath the boiler to raise the steam to the temperature, say as an illustration, at 80 pounds pressure? A. Steam in a boiler at 80 pounds pressure has a temperature of 323 deg. Fah. The fire under the boiler may be from 1,800 deg. to 2,500 deg. Fah. 2. In an electric arc, continuous current, if what is termed the "north pole" is presented to the arc, will it (referring to a magnet being presented to the arc) attract or repel? Or does it matter at what portion of the arc same is presented, near + or — carbon? A. The arc is driven in the same direction by a magnet as the pole of a magnet would be by the current. If the magnet attracts the arc when you wish to repel it, use the opposite pole of the magnet. 3. What material is it which, when suspended over a gas jet, and gas allowed to come in contact with it, becomes red hot, igniting gas? A. Spongy platinum is the substance that fires a gas jet.

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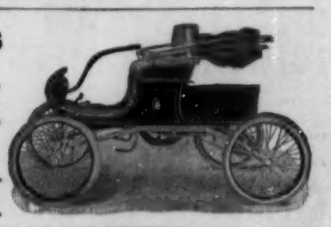

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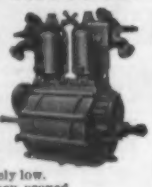

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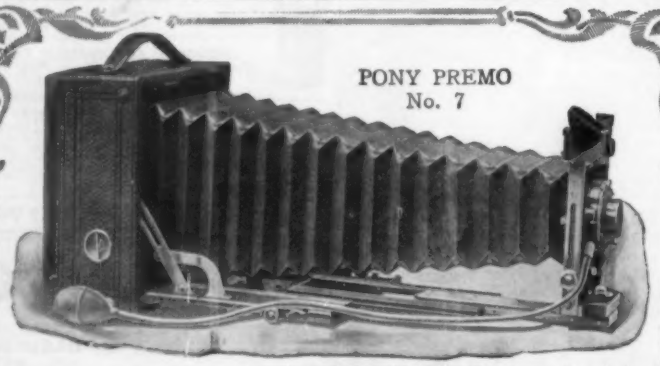

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